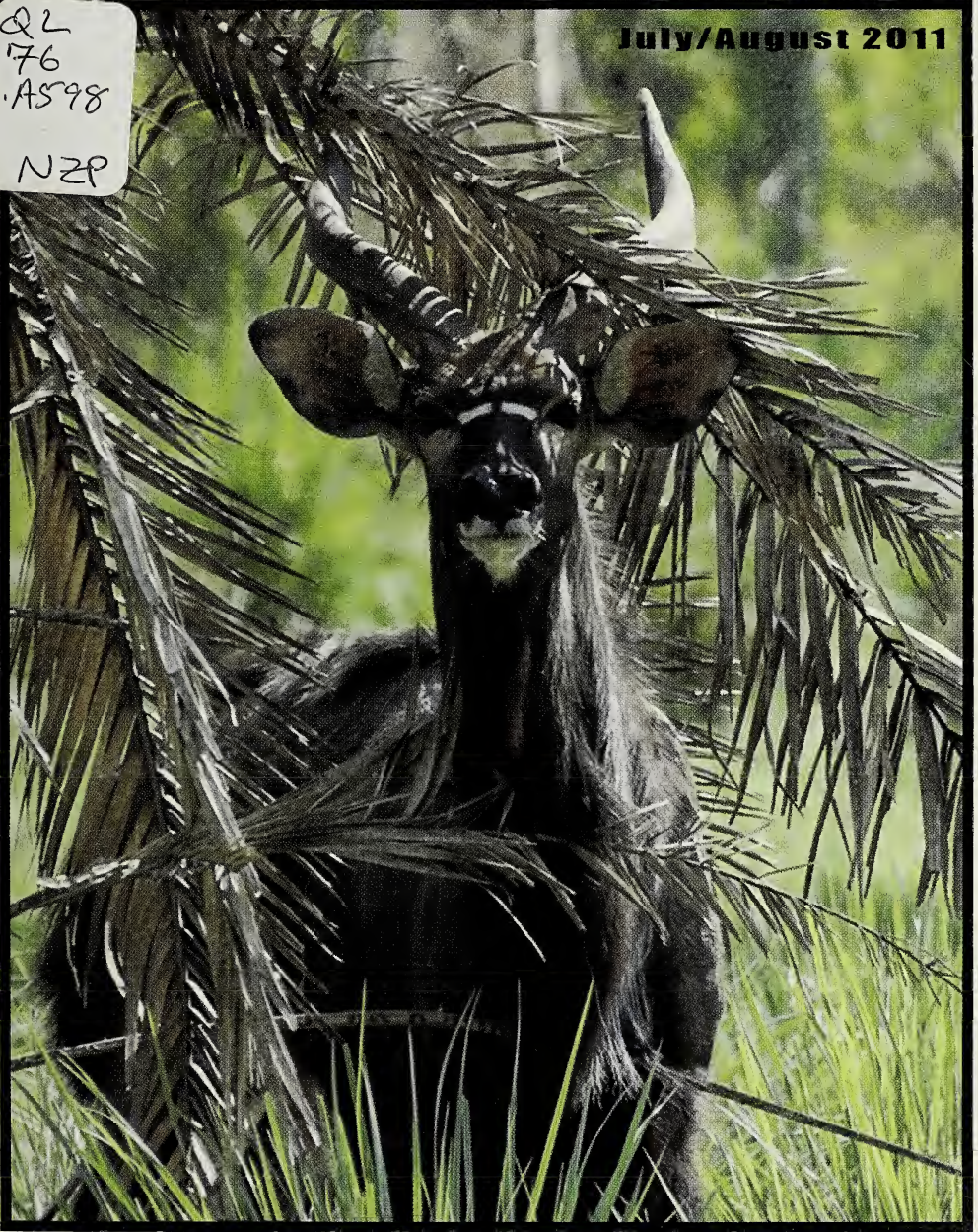


# ANIMAL KEEPERS' FORUM

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July/August 2011



**Dedicated Issue on Ungulate Husbandry,  
Training, Enrichment & Conservation**

**The Journal of the American Association of Zoo Keepers, Inc.**

**ANIMAL KEEPERS' FORUM**, 3601 S.W. 29th St., Suite 133, Topeka, KS 66614-2054

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**About the Cover** ~ This month's cover features a Lowland Nyala bull (*Tragelaphus angasii*) on the Pembe Savannah at Disney's Animal Kingdom Lodge in Lake Buena Vista, FL. This species is exhibited in a mixed-species display on the savannah outside of the Lodge where guests may observe the animals and their behaviors from their private balconies. The photographer for our Dedicated Ungulate Issue is Lindsey D. Kirkman, Animal Keeper at Disney's Animal Kingdom Lodge. Thank you, Lindsey!

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*Reticulated giraffe (*Giraffe camelopardalis*) mother and calf at Disney's Animal Kingdom Lodge*  
(Photo by Courtney Janney, Animal Keeper/Asia Trail, Smithsonian's National Zoological Park)



## **MISSION STATEMENT**

(Revised April 2009)

American Association of Zoo Keepers, Inc.

*The mission of the American Association of Zoo Keepers, Inc. is to advance excellence in the animal keeping profession, foster effective communication beneficial to animal care, support deserving conservation projects, and promote the preservation of our natural resources and animal life.*

Articles sent to *Animal Keepers' Forum* will be reviewed by the editorial staff for publication. Articles of a research or technical nature will be submitted to one or more of the zoo professionals who serve as referees for *AKF*. No commitment is made to the author, but an effort will be made to publish articles as soon as possible. Lengthy articles may be separated into monthly installments at the discretion of the editor. The editor reserves the right to edit material without consultation unless approval is requested in writing by the author. Materials submitted will not be returned unless accompanied by a stamped, self-addressed, appropriately-sized envelope. Telephone, fax or email contributions of late-breaking news or last-minute insertions are accepted as space allows. Phone 785-273-9149; FAX (785) 273-1980; email is [akfeditor@zk.kscoxmail.com](mailto:akfeditor@zk.kscoxmail.com)< Submission Guidelines may be found in the Member's Only section on the AAZK website. If you have questions about submission guidelines, please contact the Editor.

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## From the Editor

We are very pleased to be able to bring you this expanded edition of *Animal Keepers' Forum* dedicated to "Ungulate Husbandry, Training, Enrichment and Conservation". This has been made possible in part through the generosity of the sponsors listed below. Our sincere thanks to these sponsors for their support of AAZK's professional journal and their willingness to work with our association in the production of this special issue of *AKF*.

An issue like this combines the talents and efforts of many people. I would like to thank all of the authors who responded to our Call for Papers. We were pleased that so many of you who work with ungulates responded by providing papers on many ungulate species and the varied aspects of caring for this group of mammals. Our sincere thanks to the many photographers who allowed us to use their images to illustrate this issue. Special thanks go to Martha Fischer, AZA Antelope and Giraffe Chair, for helping to solicit articles as well as sponsors, and for her assistance in answering questions and supplying information as needed. I would also like to thank Martha for her encouragement and support during the production of this dedicated issue.

It is our hope that the resources contained in this dedicated issue will give you information you can utilize in providing the best practices in ungulate husbandry, training and enrichment for the animals at your facility. The information contained herein will also help you to bring about a greater understanding and appreciation for these animals in your interactions with visitors to your facilities.

This will be my last expanded, dedicated issue as I close out my tenure as *AKF* Editor at the end of 2011. While its production offered a number of challenges, it has also provided me with a great sense of satisfaction in our ability to bring you this special issue. We hope you enjoy our efforts.

Susan D. Chan, Managing Editor *AKF*

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## Opening the Corral Gate!

The Ungulate TAGs are proud sponsors of this special Ungulates-Rock double-edition of *Animal Keepers' Forum*. We are pleased with the overwhelming outpouring of fantastic articles covering a myriad of topics related to hoofstock care, husbandry, population management, training, enrichment and field conservation. Without design, the articles submitted were diverse and represented all six of the taxa of the Ungulate TAGs – so there is a little bit of something for everyone in this *AKF*, from the most high-profile of ungulates (the crowd-pleasing giraffe, the flashy zebra and the glamorous okapi are, of course, well represented) to some of their lesser-known, but equally-special relatives (the rare and endangered babirusa, Eld's deer and Speke's gazelles get some much deserved attention!). Hopefully this is just the first of many joint endeavors for AAZK and the Ungulate TAGs.

We are hoping that some of you out there thumbing through this issue of *AKF* today will be the TAG Chairs, Steering Committee members and SSP® Coordinators of tomorrow. You are a vital part of AZA Programs now (thank you for all you do!) – and we hope your involvement will grow in the future. We would love to have your involvement at the next Ungulate TAG meetings, so consider this a formal invitation to join us.

We would love to have your involvement at the next Ungulate TAG meetings, so consider this a formal invitation to join us.

### SAVE THE DATE!

2012 Ungulate TAG Meetings

24-31 March 2012 (exact dates TBD)

AZA Midyear Workshop

Hosted by the Living Desert in Palm Springs, California

We hope to see you there!

Thank you again for all you do for the care and conservation of ungulates!

Most Sincerely,

Martha Fischer, AZA Antelope and Giraffe Chair

Pat Thomas, AZA Buffalo, Bison and Cattle Interim Chair

Jeff Holland, AZA Caprid TAG Chair

Tony Fisher, AZA Cervid TAG Chair

Tim Thier, AZA Equid TAG Chair

Carmi Penny, AZA Wild Pig, Peccary and Hippo TAG Chair



# ***TAG – You’re It!***

*By Martha Fischer, Saint Louis Zoo  
Chair, AZA Antelope and Giraffe TAG*

If you are like many keepers, you may think that “AZA Programs” = “Curator Work”. Many of you may have taken one look at the title of this article and thought “Hmmm, an article about TAGs written by a TAG Chair? B-O-R-I-N-G!”

(It’s okay if you thought that – I don’t mind – I would have thought the same thing when I was a keeper. Even now as a Curator, my first inclination is to flip through this *Animal Keepers’ Forum* and read all about moose management and gerenuk training and all of the other cool articles in this issue before reading about TAGs! So, if you want to read this article last, it’s okay with me...)

Trust me, “AZA Programs” ≠ “Curator Work”. Simply stated, AZA programs would not function without keepers. Think about it. Who is the first to discover and report a birth or death of an animal that will eventually be recorded in an AZA Regional Studbook? A keeper. Who is the person directly responsible for the animal care and management that ensures the animals are healthy and appropriately managed to fulfill their AZA Species Survival Plan® breeding recommendations? A keeper. Who is the front-line employee answering the questions asked by AZA’s 150 million visitors and, at the same time, eloquently conveying the conservation messages of AZA Programs? A keeper. So, you see where I’m going with this? Although your primary responsibility is day-to-day animal care and although you may not be currently keeping a studbook or coordinating an SSP®, you are still, maybe without even realizing it, a vital part of AZA Programs. (And, we thank you for that!)

## ***AAZK/AKF FYI RE: AZA***

Let’s back up a bit and talk about AZA Programs. I am not going to lie - it is very easy to get lost in the ABCs of AZA (Association of Zoos and Aquariums), with their TAGs (Taxon Advisory Groups) and their SSPs (Species Survival Plans®) and their RCPs (Regional Collection Plans) and their ILs (Institutional Liaisons) and their IRs (Institutional Representatives) and their SAGs (Scientific Advisory Groups) and their ACMs (Animal Care Manuals)...OMG, who can keep up with all of the acronyms?! Even after 25 years in this business, I get confused with all of the different programs.

- An AZA Taxon Advisory Group (TAG) examines the management and conservation needs of a related group of taxa and develops recommendations for population management and conservation based upon the needs of the species covered and the needs of AZA-accredited institutions. TAGs develop an action plan that identifies essential goals, scientific investigations, and conservation initiatives needed to best serve *ex situ* and *in situ* populations and a Regional Collection Plan (RCP) that specifies the optimal manner in which the *ex situ* populations should be managed. The TAG is also responsible for developing an Animal Care Manual (ACM), a document that assembles basic requirements, best practices, and animal care recommendations to maximize excellence in animal care and welfare.
- An AZA Species Survival Plan® (SSP) strives to manage and conserve an *ex situ* species population with the cooperation of AZA-accredited institutions. SSP Programs develop a Breeding and Transfer Plan (AKA Masterplan) that identifies population management goals and recommendations to ensure the sustainability of a healthy, genetically-diverse, and demographically varied population.

As you may have heard, AZA has recently developed new designations for its SSP programs: Green and Yellow. Cooperatively managed populations that can retain 90% gene diversity for at least 100 years, or 10 generations, are Green SSP Programs. Green SSP Programs must adhere to the AZA Policy for Full Participation and all non-AZA member partners must be approved by the Wildlife Conservation and Management Committee (WCMC). Cooperatively-managed populations of at least 50 individuals that cannot retain 90% gene diversity for 100 years or 10 generations are Yellow SSP

Programs. Participation in Yellow SSP Programs is voluntary, and non-AZA member partners do not need to be approved by the WCMC.

- An AZA Red Program maintains a Studbook for those cooperatively-managed populations that are comprised of fewer than 50 individuals. Red Programs strive to manage and conserve a select ex situ species population with the voluntary cooperation of AZA-accredited institutions.
- An AZA Regional Studbook dynamically documents the pedigree and entire demographic history of each individual in a population of species. Studbooks are invaluable tools that track and manage each individual cared for in AZA-accredited institutions.

### *The Herd Dynamics of our Dynamic Herd*

We are hoping that this All-About-Ungulates edition of *AKF* will capture the attention of the professionals in our field who have a keen and specific interest in ungulate care, handling, management and conservation. While we have that attention, we want to take this opportunity to highlight the Ungulate TAGs for all of you and encourage your involvement in the TAGs.

There are six different TAGs related to ungulate taxa and they work closely together – Antelope & Giraffe TAG, Buffalo, Bison & Cattle TAG, Caprid TAG, Cervid TAG, Equid TAG and Wild Pig, Peccary and Hippo TAG. Each of these six TAGs is an independent group, with its own Steering Committee, its own set of managed programs and its own RCP. Even though these TAGs are distinct, they are, at the same time, working together on many activities where overlap exists between their respective taxa.

Each Ungulate TAG is facilitated by a Chair and a 14-member Steering Committee (elected from the IRs of the TAG). The Chair and the Steering Committee members volunteer for these roles in addition to their “real job” and these 15 individuals are responsible for a long list of TAG activities, including oversight of SSPs and Studbooks, development of an RCP and more! It probably sounds hard and maybe even a little boring, but in reality once you get involved, you will find that it is very satisfying to be involved with the ‘inner-workings’ of AZA’s successful programs. In addition to the leadership roles described above, there are many opportunities for zoo professionals at all levels (keepers, managers, curators, educators, vets, researchers, etc.) to offer their assistance, expertise and talent to the TAGs.

Plus – and this is the best part, in my opinion - when you are involved in the Ungulate TAGs, you get to interact directly with a group of dedicated professionals who share your passion for ungulates. There aren’t many people who can sit around and talk “hoofstock” for hours upon hours on end.... but when you are involved with the Ungulate TAGs, you are surrounded with peers who love to do just that!

Because the six Ungulate TAGs work with similar taxa, have similar interests and share similar goals, these TAGs will regularly pool resources and work together to get more done without duplicating effort. For instance, rather than develop six very similar ACMs, the Ungulate TAGs are currently developing one compiled document that will serve as an ACM for all the relevant species covered by these TAGs. By working together, the development of the ACM will be easier from the outset, plus the end result will be a more user-friendly document for keepers, managers and curators (can you imagine if you had to look through six different ACMs to find the information you need about the ungulates in your care?!)

Because zoo professionals who are interested in and responsible for one related group of ungulate taxa are often interested in and responsible for managing several other ungulate taxa as well, the six Ungulate TAGs convene together at the same meeting place once per year. We have found that convening these TAGs for one big über-TAG-meeting boosts attendance and participation, generates interest and idea-sharing across TAG boundaries and, especially important in these trying financial times, saves money by reducing the need to travel to several different TAG meetings in a year’s time.



This all-in-one meeting condenses all of the Ungulate TAG meetings to one site and one 2-3 day timespan. Typically the Ungulate TAG annual working meeting is held in conjunction with the AZA Midyear Workshop each year.

### *Join Our Herd*

The Ungulate TAG Chairs and Steering Committees are ultimately responsible for the sustainability of the TAGs and their programs. Most often we think of sustainability (a very hot buzzword in our industry right now!) in terms of making sure our animal populations can be “sustained” genetically and demographically for the future. But sustainability also has to be considered in terms of our Program Leader population. The current TAG Chairs are committed to setting up a succession plan for our TAGs and animal management programs to make sure that well-trained and well-mentored professionals are ready, willing and able to manage these programs in the future.

In August of 2010, several TAG Chairs and Ungulate TAG Program Leaders hosted a *Connecting with Keepers* workshop at the AAZK Annual Conference with hopes of fostering a relationship between the Ungulate TAGs and AAZK and of inspiring keeper participation in the Ungulate TAGs. Please read the article entitled “*Ungulate TAGs Connecting with Keepers: An Update*” by Christy Poelker in this issue of *AKF* and learn of the many ways you can become involved with the Ungulate TAGs. And please feel free to contact any one of the Ungulate TAG Chairs for more information on how to become involved:

Antelope and Giraffe TAG  
Buffalo, Bison and Cattle TAG  
Caprid TAG  
Cervid TAG  
Equid TAG  
Wild Pig, Peccary and Hippo TAG

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*Hosted by the Oakland Zoo*

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**[www.giraffecare.org](http://www.giraffecare.org)**

# Animal Management Support of Wild Equid Research at The Wilds

By Arin Moore, Animal Management Specialist  
The Wilds, Cumberland, Ohio

The Wilds, in Cumberland Ohio, is a 10,000-acre conservation center constructed on reclaimed surface mine land. The mission of the Wilds is to advance conservation through science, education and personal experience. Supporting research work is an integral part of the Animal Management programs at The Wilds. One of the most important tools we have is a hydraulic Tamer<sup>®</sup> manufactured by Fauna Research. This restraint system is a safe and effective means of restraining wild animals for veterinary care and specific research needs. The sides of the Tamer<sup>®</sup> are padded with four inches of high-density foam and the hydraulic system allows an animal to be restrained by squeezing them and lifting them off their feet if necessary. Research and veterinarian staff can access the animal from several doors on either side of the chute.



Holding areas at the Wilds are connected to the animal handling area at the center through a number of connected chutes and yards. (Photo: Toni Kellar)

Two species of wild equids at the Wilds, the Przewalski's wild horse (*Equus caballus przewalskii*) and the Persian onager (*Equus hemionus onager*), have both been the subject of collaborative research work with Smithsonian's Conservation Biology Institute (SCBI). These projects were designed to characterize the normal reproductive cycles of these species and help to develop the tools needed for artificial insemination (AI). This work resulted in the first two successful births of any wild equid through AI, two Persian onager foals born at the Wilds in 2010. The use of the Tamer<sup>®</sup> allows staff to manage the animals to facilitate research while maintaining animal and handler safety. When considering the feasibility of any research project, the animals selected, the restraint system and the facilities surrounding it stress management, and individual and species response to the manipulation must be considered.

The Przewalski's wild horse and the Persian onager herds are managed in a semi-free range environment at the Wilds. Their home pastures are approximately 78 and 100 acres respectively. Because these animals are managed in such large open spaces, they are not easily handled in close



contact. The Tamer® allows animal management staff to safely restrain the animals allowing the research and veterinary staff to conduct their research. Animals selected for a research project are moved from the pasture and into holding yards adjacent to the animal handling area which includes the Tamer® and veterinary clinic. Almost every animal at the Wilds passes through this complex each year for their routine annual exams.

Animal management staff works alongside the research staff to help select which animals are included in each project. Some research work requires that animals may be taken out of regular production and/or management plans, and this may need to be coordinated with species population managers. Animal management staff keeps records of how animals respond each time they are brought to the holding yards for procedures. If an animal is particularly fractious or is not cooperative, it may be excluded from the project. Staff must also consider whether or not to work with a female with a foal at her side. The age of the foal is generally a determining factor. If a foal is not old enough to be weaned, staff will have to accommodate working the younger animal along with the project animals.

The facilities surrounding the restraint chute are as important as the restraint itself. It is necessary to have adequate sized yards in close proximity to the handling area to house the animals for the duration of the project. The Wilds has a chute system that connects its holding yards to a series of small paddocks. Animal management staff uses these paddocks to sort out individual animals, which are then run through a smaller chute leading to the Tamer®. This smaller chute includes a final right angle turn designed to slow the animal down before entering the restraint. A push wall after this turn allows staff to keep the animal moving into the Tamer® in case it hesitates or turns around. Once the animal is in the proper position, the operator can squeeze the sides of the Tamer® together, effectively restraining the animal. The animal can be lifted off its feet if more control is needed. A custom-built kick board was added to keep staff safe when opening the Using the Tamerrear door of the Tamer® for access to the animal from behind, for instance for reproductive work. Custom-built stands were also constructed for easier access while using the ultrasound equipment.

Even with these facilities, working a research group of animals requires a significant commitment of staff time. Two or three animal management staff members are required to sort individual animals from the herd in the paddocks and send them through the chute. At least two more staff members are required to run the Tamer®: one to operate the hydraulics, and the other to help position the animal. Additional staff members are needed to manage cut-off doors along the chute to keep the animals moving forward. These duties are often covered by members of the research or veterinary team. Palpation and ultrasound can take only a few minutes, but artificial insemination requires more time.

It is critical that there is good communication between animal handlers and the research staff. Each team must have a plan, but be ready to make adjustments as needed, depending on the reactions of individual animals. What works early in the course of a project may not work as the animals learn the system. Plans have to evolve and communication will help keep the procedure as stress-free as possible, which is imperative, especially if an insemination is being attempted. The use of sedative drugs to help keep the animals calm during a project, while useful in some species for some procedures, can make some animals less responsive and more difficult to sort and move through the chute.



Using the Tamer®, Dr. Vick prepares for ultrasound exam on Persian onager mare. (Photo: Arin Moore)



Animal management staff can compensate in different ways to help minimize stress,. Animals that become very nervous while split from the herd are run through the Tamer® first so they can quickly be reunited with the research herd. If an animal is hesitant to exit a paddock through a given door, other doors are available to give staff and animals multiple options. Dams can become overexcited quickly if they are separated from their foals that may make them unwilling to move. The staff learned to send the foal ahead of the dam so that she would follow it through the chute into the Tamer®. Every attempt should be made to keep the restraint time brief. Research staff should be prepared to work as quickly as possible. Animal management staff is constantly communicating with the research and veterinary staff while the animal is in the tamer, keeping them informed of the animal's status.

It is important to recognize different species of animals react in different ways. Problems can



Research group of Persian onagers moving from holding yard to sorting area. (Photo: Arin Moore)

occur while moving the animals as well as while they are restrained. For instance, Przewalski's wild horses tend to be relatively easy to sort and move though the chutes, while the onagers become stubborn and are more likely to stand and kick. As the onagers become more aggressive, they become more difficult to work within the small sorting paddocks. As one onager mare learned the system, the only way staff could get her to move was to follow behind her with a push board. The Przewalski's wild horses were especially sensitive to being separated from the other animals. Once in the Tamer®, the Przewalski's wild horses were more likely to rear up,

delaying our ability to restrain it by squeezing. Even after the animal is restrained, it may continue to fight. Staff found that the onagers are more likely to attempt to bite handlers while being restrained. Both species have the ability to scoot forward in the Tamer®, even after they have been squeezed and lifted. We had some success using a foam pad at the head end to force animals to the rear to allow easier access for palpation or ultrasound.

After a project is finished, the research animals have to be reintroduced to the main herds. The Przewalski's horses and onagers are managed in 78 and 100-acre pastures respectively, which allows ample space for reintroductions. After the research animals are returned to pasture, at least one staff member monitors the herd for the remainder of the day. It has been found that the two equid species integrated back into the herds differently. With the onagers there is minimal aggression and normal behavior resumed quickly. The Przewalski's wild horses presented more problems during reintroduction. Minimal aggression was observed but the reintroduced horses were chased some by the main herd. Dominant mares had little trouble rejoining the main herd and resuming their role within the herd, while it took more time for less dominant mares to be accepted again.

Animal management staff at the Wilds work closely with researchers to help support their projects. The Tamer® restraint system has proven to be an effective method to restrain wild equids during a research procedure without the use of chemical restraint. Animal management and research staff must carefully consider which animals should be included in a given project. Well-designed facilities play a major role in how well the animals move to and from the handling area and in minimizing overall stress on the animal. Minimizing stress levels is critical for both animal welfare and research results. Good teamwork between animal managers and researchers helps make the programs at the Wilds a success.





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# Teaching Young Giraffe Old Tricks: Changing Learned Behaviors in a Herd of Captive Giraffe

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## Abstract

At Lion Country Safari (LCS) in Loxahatchee, FL, a sub-tropical climate and the adoption of unnatural behavior by the captive giraffe herd have collided to pose a threat to the health of the giraffe (*Giraffa camelopardalis*). In recent years, a resilient parasite known as *Haemonchus contortus* has become prevalent in the pastures where the giraffe are housed and has developed resistance to many standard de-worming drugs (Garretson, 2009; Lange, 2006; Miller and Barras; 1994, Waller, 1994). *H. contortus* feeds on the host's blood while residing in the abomasum of ruminants and severe infestations can lead to anemia, "bottle jaw" and even death (Leite-Browning, 2006). The subtropical climate of south Florida provides a perfect combination of year-round moisture and heat for these parasites to thrive (Heath, 1991; Leite-Browning, 2006). The pairing of increased grazing behavior in the giraffe with the presence of *H. contortus* in the pasture has resulted in increased parasite loads in the giraffe. The giraffe have become so accustomed to grazing that each generation is learning this behavior from their elders and are often seen lying down and grazing throughout the day. The consequences of these learned behaviors pose the staff at LCS with a dual mission: stop the giraffe from grazing and control parasite levels. To address this problem, LCS adopted several new practices in the management of the giraffe. These changes help to curb the giraffes' grazing habit, make the pastures less habitable for *H. contortus* and reactively deal with the ramifications of *H. contortus* infections.

Unlike their wild counterparts, captive giraffe are not subjected to pressure from predators or food restrictions (Grandia, 2001; Veasey et al. 1996). However, problems can surface as a result of their environment, as has been seen at LCS. As animal care professionals it is our duty to provide the best environment possible for the animals in our care and to promote naturalistic behaviors. This paper will discuss actions being taken both proactively and reactively to combat *H. contortus* in the giraffe collection at LCS and strategies to encourage natural behavior in our captive giraffe.

## Introduction

LCS is a 350-acre drive thru safari that houses large groups of animals in large open exhibits. The giraffe collection includes 15 individuals and is divided into two groups: the feeder herd and the preserve herd. The feeder herd includes 4.1 giraffe between five and seven years old that are housed in a half-acre public feeding exhibit seven hours a day and a separate half-acre pen at night. The preserve giraffe herd includes 2.8 individuals ranging in age from five months to 20 years. The preserve herd is housed in a two-thirds-acre pen each night for 16 hours and during the day is released to the drive thru safari preserve, which is a 23-acre section of pasture with a road traveling through it. Both herds are often seen lying in groups grazing the pastures. As they are grazing, they are consuming the parasite *Haemonchus contortus*, which has already reached the L-3 level of its life cycle. L-3 is the infective larval stage, which crawls up a blade of grass and waits to be ingested by a suitable host (Leite-Browning, 2006). Once in the abomasum (or "fourth stomach") of a ruminant host, *H. contortus* matures to the L-4 (pre-adult) larval stage within a few days. After a molt, the L-4 develops into the L-5, or adult stage (Leite-Browning, 2006). The adults breed and feed on blood in the abomasum and thousands of eggs can be released from each adult female through the feces of the host each day (Leite-Browning, 2006). The eggs then rely on a warm, moist environment to develop in the manure (Leite-Browning, 2006). In suitable conditions, the *H. contortus* eggs will further develop into the L-1 and L-2 juvenile stages of its life cycle (Leite-Browning, 2006). While feeding on bacteria in the manure, juvenile *H. contortus* wait to mature to the L-3 stage, at which point they will crawl up the blade of grass to wait for a host and begin the cycle again. The fact that the preserve herd typically utilizes only a fraction of their exhibit tends to highly contaminate one area of pasture with the parasite *H. contortus*. The presence of the parasites in the pastures combined with the increased grazing behaviors in the giraffe has resulted in significant *H. contortus* infections in the



giraffe. Infections can lead to anemia, unthrifty appearance and even death (Leite-Browning, 2006).

As in most species, the lifestyle of a captive giraffe can be described as less taxing than a wild giraffe. Captive giraffe generally spend less time consuming food and searching for suitable food and water than their wild counterparts (Veasey et al., 1996). In fact, wild giraffe have been observed to spend time feeding during every hour in the day (Dagg and Foster, 1979), while the captive giraffe at LCS are provided all dietary needs in two feedings each day. The reduction of space and lack of pressure from predators, dominant animals and sexual opportunities can result in a decrease in behavioral opportunities (Veasey et al. 1996) and can possibly lead to boredom in captive individuals.

It has been shown that giraffe will develop undesirable (and stereotypic) behaviors in captivity including the licking of non-food items and pacing (Bashaw, 2001).

Perhaps evolving from boredom, the grazing behavior in the giraffe at LCS has proved to have damaging effects to the health of the herds by increasing both the frequency and the severity of *H. contortus* infections. In fact, *H. contortus* infection was the main contributor to the deaths of two female giraffe at LCS in late 2006 and early 2007. Furthermore, young calves are mimicking the older giraffe that now graze throughout each day. In order to address the problem, LCS staff adopted several new practices in the management of the giraffe.

Several of these practices were introduced to proactively diminish behaviors leading to *H. contortus* infestation in the giraffe, decontaminate pastures and encourage natural behaviors. If an animal has an unacceptable parasite level, additional reactive measures are taken to ensure the animal's parasite load is reduced to an acceptable level.



A young giraffe lying down and grazing shortly after release into the preserve at Lion Country Safari.

### Proactive Practices

Several proactive approaches have been adopted to encourage the giraffe to display more naturalistic behaviors while reducing their urge to graze. Two of these approaches include the addition of browse hangers in the exhibit and access into forested areas at night. The browse hangers enable keepers to hang browse up to a height of 19 feet via a cable and crank system in the exhibit that has no



The preserve giraffe herd browsing from one of two browse hangers in their exhibit.

natural browse. Keepers collect a large piece of browse from one of several non-toxic but invasive tree species on LCS property. The branch is transported to the browse hanger in the keeper trucks and a Velcro® strap is used to secure the branch to a snap link clip and cable. The branch is then cranked up to hang at heights the giraffe can reach in a standing position. Large branches are hung at least once a day to enrich the giraffe and to promote natural behaviors. Even if a branch is stripped of leaves and bark it will continue to provide the giraffe with enrichment as they use the branch to rub on. Puzzle feeders and other enrichment items are also hung on the browse hangers. Two widely spaced browse hangers in the giraffe herd section encourage the giraffe to utilize the entire section, rather than one concentrated area. The feeder giraffe herd is given access to a 13-acre cypress head, or forested area, at night. Like the browse hangers, this offers plenty of enrichment and encourages natural browsing behaviors. This area was previously unused and undeveloped, so with only a few minor alterations in fencing for containment purposes, this area was made available to the feeder giraffe herd. All of the giraffe in this herd are conditioned



to return to their holding area by the morning. If they have not done so, keepers ring a cowbell to “call” them back to the pen. When they do arrive, the giraffe are rewarded with produce and praise. A side note on this subject is the reactions of the giraffe upon introduction to the cypress head at night. When the giraffe were first given access to this large forested area only two of the five animals involved walked to the area without reservation. Two others took several days to a few weeks to venture out to the cypress head, and the one female in the group still has not built up the gumption to explore the area. For the participating giraffe, this practice helps to prevent boredom and reduces time spent lying down and grazing.

Another proactive tactic to curtail grazing behaviors is to change the public feed option at the giraffe-feeding platform. Generally rye crisp crackers are sold to the public to feed to the giraffe. The giraffe eat the crackers without hesitation, but they prefer other food options such as produce and browse. If the feeder giraffe seem to be getting bored with the crackers, or are lying down and grazing, staff will introduce small pieces of browse for the public to feed. This practice will usually renew the giraffe’s interest towards the feeding platform and they will return to the platform to engage the public.



Two giraffe from the feeder herd roam a forested area before returning to their display.

Puzzle feeders and additional feeders are another tool we have used to change the herds’ habits. Usually grain is dispersed twice a day to the giraffe in large feed troughs and bins that are elevated on a feeder. Additional feeders were built in the section to compel the giraffe to utilize more space while feeding. Puzzle feeders have also been added to make grain consumption a little more challenging. These feeders force the giraffe to spend more time consuming feed and minimizes “free time” which is usually spent grazing.



An adult female giraffe uses her tongue to retrieve leaves and grain through a puzzle feeder.

The staff involved with the giraffe herds regularly engages all giraffe in operant conditioning. This program encourages the giraffe to learn new behaviors and to focus on the tasks at hand. The training sessions have been an excellent way to keep the giraffe busy and enriched during sessions. Most giraffe are eager to train each day and enthusiastically enter each session. This practice also enables staff to closely monitor the giraffe for any changes in condition or behavior, allows for voluntary blood draws in most individuals and helps in administering medications.

An additional strategy used to battle *H. contortus* is the use of monogastric grazers and mechanical pasture cleaners. The introduction of miniature Sicilian donkeys (*Equus asinus*) and plains zebra (*Equus burchelli*) to the pastures where the giraffe are housed has several benefits. These equids are unaffected by *H. contortus* and act as a dead end host to the parasite which requires the abomasum of ruminants to develop (Garretson, et al, 2009). If the parasite is ingested by a non-ruminant or monogastric (one-stomach) animal it will not develop into the adult life stage and therefore, will not breed. These monogastric grazers help to keep the grass short, which exposes the parasites to direct sunlight, and can help decrease the larvae population (Leite-Browning, 2006) by creating a less habitable environment. Short grass may also make the pasture less desirable to the giraffe for grazing. The miniature Sicilian donkeys are kept in the holding pens and the feeding giraffe display yard to graze these areas. In the preserve giraffe herd



pasture we utilize our substantial zebra herd to help with the pasture decontamination. A herd of 64 plains zebra is given access to the giraffe section every night. Once the giraffe are put into their night pen, the zebra are given access to the pasture for over 14 hours until the next morning, enabling them to graze the 23 acres where the giraffe spend each day. This practice also benefits the zebras, allowing them more pasture to graze. The zebra herd is conditioned to return to their usual display area each morning. A pasture cleaner, or pasture vacuum pulled by a tractor is also utilized regularly to help remove manure from the giraffe feeding display yard and other holding pens in a quick and efficient manner.



LCS's herd of 64 Plains Zebra act as a "dead-end" host to *H. Contortus* as they graze the pasture.

The giraffe staff is also involved in a vigilant fecal sample collection program and is watchful for any symptoms typical of a *H. contortus* infection. In *H. contortus* infections, the number of parasitic eggs present in the host's feces can act as a measure of the severity of the infection. At LCS, each individual giraffe is on a regimented fecal collection schedule in order to monitor fecal egg levels closely. Fecal samples are collected monthly from individuals that are healthy, do not exhibit symptoms, and have not recently had high levels of fecal egg counts. Individuals that may be of concern to the veterinarian because of physical or environmental stresses (i.e. pregnant or lactating cows or social changes in the group) are put on a more frequent fecal collection schedule. This fecal collection program allows the veterinarian to monitor each giraffe closely and detect infections before they become severe. At LCS symptoms are not typically presented in giraffe until *H. contortus* infections are considered more severe. An animal infected with *H. contortus* may present with "bottlejaw", or accumulation of fluid in the lower jaw, appearance of sunken in eyes, poor coordination, poor coat condition, pale mucous membranes, dehydration and diarrhea (Leite-Browning, 2006). If symptoms do arise, the veterinarian is alerted and a fecal sample is collected.

### Reactive Practices

If an individual's fecal egg count is elevated and/or a giraffe exhibits symptoms synonymous with *H. contortus* infection, additional action is taken to quickly regain the health of that animal. The first reactive response to a high parasite level in a giraffe is to move the animal of concern into a dry lot, or holding pen containing no grass or plant life. This ensures the giraffe will not be grazing and ingesting more parasites, which could cause reinfection. The dry lot contains a hard substrate, which is less comfortable than grass to lie on, and the giraffe are rarely seen lying down there. If prescribed by the veterinarian, the giraffe is typically dewormed with copper oxide wire particles (COWP, Copasure®, Animax Ltd., Columbus, OH 43215 USA) or moxidectin® to help reduce the parasite load. *H. contortus* samples taken from the pastures of LCS have shown to have resistance to many deworming medications. In these studies, only moxidectin was shown to be effective in killing the parasites from LCS. LCS is also currently involved in a plasma moxidectin study to help develop proper dosages and application of the drug in giraffe and to help prevent further resistance.

In the past, the giraffe herds were typically dewormed several times a year, the new targeted deworming practice has helped to reduce deworming costs at LCS. Weights on each giraffe are recorded regularly to assist the veterinarian in prescribing the correct amount of drug. Fecal samples are then collected one week after copper administration and two weeks after moxidectin® treatment to ensure the parasite load in the animal was significantly reduced. While in the dry lot, individuals are also offered browse and enrichment items throughout each day and are occupied in frequent training sessions to both enrich and encourage natural behaviors. These individuals are also under close

scrutiny for any change in condition and fecal samples are collected regularly to monitor parasite levels. Blood samples are also taken from willing individuals to help the veterinarian monitor blood values. Once fecal samples test negative for parasitic activity the animal is left in the dry lot for at least one more week. When the individual is released back with its herd, it is closely monitored and routine fecal sample collections continue.

Some other techniques to decontaminate pasture include controlled burns and pasture rotation (Leite-Browning, 2006); however these are not options at LCS due to space and shelter limitations. Another known assailant to most parasites is a winter freeze (Leite-Browning, 2006), which occurs in most North American captive environments. Unfortunately, this relief does not occur in the subtropical south Florida climate.

## Conclusion

In conclusion, the parasite problem in the giraffe herds at LCS has become a significant issue that has required changes in the management of the giraffe herds. Although wild giraffe have been seen eating grass (Kingdon, 1979), these animals are not confined to concentrated and/or contaminated pasture. Furthermore, wild giraffe do not habitually exhibit these behaviors for long durations of time (Kingdon, 1979). In addition to practices already introduced, there is discussion of adding slow release food dispensers, which would require the giraffe to spend more time and energy in food consumption. A few other ways to combat this parasite is the use of nematophagous fungi and highly condensed tannin legumes (Lange, 2006; Leite-Browning, 2006; Shaik, et al., 2006), which can be fed to the giraffe to help reduce parasite concentrations in the pasture.

*H. contortus* has established itself in the pastures of LCS but the management of the giraffe herd is showing to have minimized severe *H. contortus* infections in these animals. The presence of this parasite, and the ideal climate that south Florida provides for *H. contortus* are two elements in this equation that cannot be easily changed. The behaviors of the giraffe, however, can be altered with persistence, dedication and teamwork. The LCS staff now works together as a team to help the giraffe stay healthy and enriched, to watch for signs of infection, and to share new ideas for future plans in management.

## Acknowledgements

I would like to thank Beth Hammond, DVM, Brenda Irvine, Terry Wolf and all the wildlife staff at Lion Country Safari for their tireless dedication to the giraffe. I have no doubt that LCS will have continued success with keeping our giraffe enriched and healthy with the determination our team has!

**Photos:** All photos for this article by Ashleigh Kandrac

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## Ruminant Browser Nutrition Workshop - Synopsis

By

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The following article is a synopsis of the Ruminant Browser Nutrition Workshop (RBNW) that was held in 2009 and distributed through the Antelope TAG and American Association of Zoo Veterinarians (AAZV) and Nutrition Advisory Group (NAG) listservs. It also contains a section explaining the basics of ruminant nutrition that was taken from The Giraffe Nutrition Workshop in 2005. The Identified Research Needs and Diet Calculator were not included in this condensed form. The recommendations that come from RBNW are meant for all browsers, including giraffe, superseding the recommendations that were made for giraffe in 2005. There is still a lot to learn about the needs of exotic ruminants and it is hoped that with each passing year our knowledge of these intricate species will continue to grow.

In May 2005, the Giraffe Nutrition Workshop (GNW) was held at Lincoln Park Zoo. It brought together university researchers specializing in ruminant nutrition with zoo nutritionists, veterinarians, pathologists, managers, and feed manufacturers. Some zoo giraffes have maladies that are affected by nutrition. Peracute mortality, chronic wasting, energy malnutrition, mortality related to cold stress, pancreatic disease, urolithiasis, neonatal health issues, intestinal parasitism, and hoof disease may be influenced by zoo diets (Fowler, 1978; Fowler and Boever, 1986; Junge and Bradley, 1993; Flach, 1997; Ball et al., 2002; Clauss et al., 1999; Potter and Clauss, 2005; Lechowski et al., 1991; Wolfe, 2003; Wolfe et al., 2000; Miller et al., 1999; Eid and Rawhia, 1996). Recommendations for a low starch (<10% DMB), high acid detergent fiber (25-30% DMB) diet emerged from this workshop.

Manufactured feeds meeting these recommendations have been created and fed with varying results. In the early stages for some institutions it appeared that the recommended diet was not calorically dense enough for small ruminants (<50 lbs or 22.7 kg) and a new, more calorically dense diet was formulated.

Some positive results observed with the low-starch, high-fiber diet include decreased incidences of bloat, a reduction in regurgitation and rumen fluid seen in nostrils, decreased appearances of distended abdomens, and an appropriate shift in serum mineral concentrations (M.L. Schlegel, D.A. Schmidt, & E. Valdes, personal communications). However, some institutions claimed to experience problems such as low body weight, poor body condition, and diarrhea. Discussions of these issues appeared on listservs and at the 2008 Antelope TAG meeting.

To further support the need for ruminant diet changes, zoo pathologists were asked to share their findings on ruminant necropsies:

"In thirteen years working as the Staff Pathologist, I have come to expect ruminant forestomachs will

have microscopic lesions of hyperkeratosis and intraepithelial pustules. While these lesions may not have resulted in clinically obvious or gross lesions, the histology findings are consistent with ruminal acidosis and sub-optimal nutritional health. In addition, I suspect that I am seeing atrophy of salivary glands of hoofstock with increased connective tissue and reduced glandular-secretory development, though to confirm this finding I would have to study banked salivary gland specimens.”

---Mary Duncan, BVMS, PhD, Diplomate ACVP, Saint Louis Zoo

“Routine post-mortem evaluation of ruminants from the San Diego Zoo and San Diego Zoo’s Wild Animal Park (currently known as the San Diego Zoo Safari Park) frequently reveals rumen lesions (inflammation, hyperkeratosis) that are characteristic of those documented in domestic ruminants on diets high in starch. While it is possible that other factors could contribute to the development of these lesions in captive exotic ruminants, examination of starch contents in diets would be the recommended starting place for any effort to reduce these pathologic changes.”

--Ilse Stalis, DVM, Diplomate ACVP & Rebecca Papendick, DVM, Diplomate ACVP, San Diego Zoo Global

Disney’s Animal Kingdom began feeding low starch diets to their browsing herbivores in 2004. “A subjective review of retrospective necropsy records before and after the 2004 diet change indicates that lesions of ruminal acidosis (microabscess formation, hyperkeratosis, and papillary atrophy) are uncommonly diagnosed in the latter years. Prior to the diet change, these lesions occurred in the majority of rumen samples examined histologically. Currently, such lesions are rare.”

--- Scott Terrell, DVM, Diplomate ACVP, Disney’s Animal Kingdom

Many of the problems appeared to be in browsing ruminants, which is what prompted the Ruminant Browser Nutrition Workshop (RBNW) held in September 2009 at Saint Louis Zoo. Many of the same academic specialists from the GNW participated in the RBNW with additional representatives from animal curators/managers participating. After reviewing the issues, new dietary recommendations were made for browsing ruminants and potential areas of research were identified. By sharing the ideas and recommendations that evolved from this meeting, we hope to improve the diets and subsequent health of the captive browsing ruminants cared for by zoo professionals.

### **Ruminant Nutrition Review** (*taken from GNW*)

Ruminants and the closely related pseudoruminants are ungulates that are even-toed (Artiodactyla), chew their cud (ruminant) and have stomachs with three (pseudoruminants) or four (true ruminants) compartments (Church, 1988). The pseudoruminants include the Tragulidae (mouse deer or chevrotains) and the Camelidae (camels, llamas, alpaca, etc.) families. The true ruminants include three families; the Cervidae (deer), Giraffidae (giraffe and okapi), and Bovidae (ruminants with horns that are not shed). The ruminant stomach is comprised of the reticulum, rumen, omasum, and abomasum. The first three compartments store and delay passage of ingested food. This allows time for remastication (cud-chewing or rumination) which decreases particle size and enhances fiber digestion (also called fermentation) (Hofmann, 1988). The reticulum is often called the ‘honeycomb’ due to its mucosal pattern. The rumen is the major site of fiber fermentation. The surface of the rumen is covered with papillae and micro- papillae, which increase the absorptive surface area of the rumen. Papillae distribution, size, and number vary based on feeding habits and food availability (Hofmann, 1988). The omasum controls the flow of digested or indigested food into the abomasums. Ruminants with limited fiber fermentation capacity have the ability to allow larger fibrous particles that can not be broken down sufficiently in the rumen to pass into the abomasums (Hofmann, 1988). The fourth compartment (abomasum) is the true stomach and is lined with glandular mucosa that secretes hydrochloric acid and pepsin as in other mammals (Hofmann, 1988; Merchen, 1988). The ruminant animal is considered unique because of its four-compartment stomach, but specialization has occurred throughout the gastro-intestinal tract (Hofmann, 1988). Additionally, ruminants have taken advantage of a wide variety of feedstuffs from high-fiber, low-protein grasses and tree parts; roots and tubers, to high-protein browse leaves.

A symbiotic relationship exists within the rumen providing an environment for bacteria, protozoa, and anaerobic fungi to live while these microorganisms provide the process through which fibrous feeds are digested and fermented, yielding protein, short-chain fatty acids, and vitamins utilized by the ruminant. Ruminal pH is normally between six and seven, and the rumen is buffered with the



addition of saliva, balancing the acids produced during fermentation (Yokoyama and Johnson, 1988). The ruminants' protein requirement is met from two sources. The first is the dietary protein that bypasses ruminal degradation and reaches the abomasum and small intestine. The second source is from microbes that leave the rumen and are digested and absorbed in the abomasum and small intestine similar to dietary protein. Microbial protein can represent 40 to 60% of the non-ammonia nitrogen reaching the small intestine (Owens and Zinn, 1988). Ruminal microbes not only reproduce using dietary protein (i.e., amino acids), but also ammonia-nitrogen. Ammonia-nitrogen is supplied through dietary non-protein nitrogen (e.g., urea) from the saliva and recycled from the animal's blood (Owens and Zinn, 1988). This continual recycling of nitrogen to the rumen allows ruminants to subsist on low-protein diets. In general terms, dietary nitrogen, in the form of protein, feeds the ruminal microbes and the microbes then become the protein source to the ruminant animal. The majority of the diet consumed by ruminants is in the form of carbohydrates. These carbohydrates are polymers of glucose in the form of cellulose or starch (Fahey and Berger, 1988). Starch, made of  $\alpha$ -1,4-linked glucose molecules, can be digested by the ruminant and other mammals because enzymes are produced that break the  $\alpha$ -1,4 linkage. Cellulose, the main structural carbohydrate of plants, is also comprised of glucose molecules, but linked through  $\beta$ -1,4 linkages. Enzymes to degrade  $\beta$ -1,4 linkages are not made by mammals, but are synthesized by ruminal microorganisms. The ruminant and the microbes have a symbiotic relationship to efficiently utilize fibrous feeds (Van Soest, 1994). The rate at which carbohydrates are fermented differs. Soluble carbohydrates (sugars and starches) are digested rapidly, followed by soluble fiber (pectins, hemicellulose), with the slowest fermenting fibers being cellulose (Owens and Goetsch, 1988). The fermentation of forage diets, producing short-chain fatty acids (acetate, propionate, butyrate), provides 50 to 85% of the metabolizable energy used by the ruminant (Owens and Goetsch, 1988). In addition to the ruminal microbes providing energy in the form of short-chain fatty acids and nitrogen as microbial crude protein, the microbial population of the rumen also synthesizes the B vitamins and vitamin K required by the animal. The other fat-soluble vitamins (A, D, and E) are required from the diet as occurs in non-ruminant mammals (Huber, 1988). Vitamin D can also be synthesized *in vivo*.

Acidosis is a condition of high acidity of the blood or acidic conditions in the rumen (Huntington, 1988). The ingestion of a large quantity of readily fermentable carbohydrates provides the substrate for the rapid replication of microorganisms that synthesize lactic acid (Van Soest, 1994). Sources of readily fermentable carbohydrates include tubers or roots, cereal grains, or immature, rapidly-growing forages (Huntington, 1988). Cereal grains are the most common source of readily fermentable carbohydrates that cause acidosis through the production of lactic acid (Van Soest, 1994). Lactic acid is a stronger acid than the short-chain fatty acids. Due to the rapid production of lactic acid, ruminal pH can drop below 4, and if produced in large amounts, it is absorbed across the ruminal wall and into the blood resulting in systemic acidosis (Van Soest, 1994). Acidosis can be prevented by limiting the quantity of readily fermentable carbohydrates in the diet, slowly adapting animals from a higher-fiber diet to a lower-fiber diet, monitoring daily changes in feed intake of diets high in readily fermentable carbohydrates, and providing fresh feed and water daily (Huntington, 1988).

Ruminants consume a wide variety of feed types with a range of moisture contents. For example, a pelleted diet or supplement contains 10% moisture (90% dry matter) whereas ear-leaf acacia leaves (*Acacia auriculiformis*) contain 69% moisture (31% dry matter). At first glance, one may consider the pellet a superior protein source if it contains 16% crude protein and the acacia leaves contain 7% on an as-fed basis (as it is consumed by the animal), but when expressed on a dry matter basis the pellets contain 17.8% crude protein and the acacia leaves contain 22.6%. When ruminant diets are formulated, nutritionists evaluate the nutrients on a dry matter basis, thereby, removing the variation of feed moisture content.

Ruminant animals have been uniquely adapted to take advantage of a compartmentalized stomach and a symbiotic relationship with microorganisms to efficiently utilize a high-fiber diet. This relationship in combination with the ability to recycle nitrogen makes them able to survive in many environmental niches from the arctic to the desert. Although ruminants are adaptable to many different diets, sudden dietary shifts can produce digestive disorders and even death. Therefore, appropriate diets and enrichment items must be fed at all times.

## Browsers vs. Grazers

Ruminants can be classified by their feeding strategy. On one end of the spectrum is the grazing ruminant, and at the other end, the browsing ruminant. The grazing ruminant primarily consumes coarser grasses at fewer, longer feeding bouts. Examples of grazing ruminants are cattle, water buffalo, banteng, gemsbok, and blesbok. The browsing ruminant primarily consumes specific parts of trees and shrubs, which may include leaves, buds, fruit, twigs, and/or bark. Browsing ruminants generally feed more frequently but for shorter feeding bouts than do grazing ruminants. Examples of browsing ruminants are duikers, moose, gerenuk, giraffe, and kudu. There are numerous examples of species that are intermediate in their consumption, and will consume both grass and browse material. This strategy generally involves a seasonal transition between diet items. Examples of intermediate ruminants are sheep, goats, and many eland and gazelle species (Hofmann, 1973; Van Soest, 1987).

Nutritionally, browse item compositions can vary substantially from grasses (reviewed by Duncan and Poppi, 2008). In general, browse items tend to have more cell contents and readily digestible components, as well as more secondary plant compounds (e.g., tannins, terpenes, other phenolic compounds). Grasses tend to have more cell wall and fibrous components than browse, with the exception of lignin which can be significantly higher in woody browse items than in grasses. These are generalities of nutritional content of browse versus grass and can vary significantly due to season, location and other environmental factors. An example of the composition of different plants and plant components is given in Table 1. As a result of these different dietary components, rumen fermentation end products vary between browsing and grazing ruminants. In East African ruminants, the acetate: propionate ratio from the rumen was dramatically greater for grazing ruminants than for browsing ruminants (Hoppe, 1977).

Evolutionarily, browsing ruminants are thought to be the predecessor to the grazing ruminant. There are numerous anatomical and physiological differences that are hypothesized in browsing ruminants versus grazing ruminants (reviewed by (Duncan and Poppi, 2008)). These include: differences in oral cavity anatomy, rumen size, rumen morphology, rumen retention time, rumen musculature, rumen content stratification, and rumen bypass capacity.

Differences in oral cavity anatomy between browsing ruminants and grazing ruminants include a larger mouth opening and lip size in browsing ruminants, as well as more tongue mobility and narrow pointed incisors. In contrast, grazing ruminants tend to have smaller mouth openings, smaller lips and broad, flat incisors. Browsing ruminants also tend to have larger salivary glands, which provide an opportunity for production of proteins that can bind secondary compounds (e.g., tannin binding proteins; Robbins et al., 1991; Robbins et al., 1995). Both browsing and grazing ruminants also utilize saliva as a source of buffering (due to bicarbonate presence) and potentially phosphorus and nitrogen recycling (MacDougall, 1948).

Rumen size (or more specifically reticulo-rumen volume) has been shown to vary between browsing and grazing ruminants. On a metabolic body weight basis, grazing ruminants have greater reticulo-rumen volume than do browsing ruminants (Hoppe, 1977). These data have limitations however, in that there are no very small grazing ruminants, so the data set for grazing ruminants is skewed towards very large body size.

Rumen morphology is thought to vary between browsing and grazing ruminants. Rumen musculature is less developed in browsing ruminants than in grazing ruminants (Clauss, Lechner-Doll et al., 2003), and browsing ruminants are thought to have more evenly sized and distributed papillation of the rumen, with greater surface area compared with grazing ruminants, who have papillae that vary considerably in length from dorsal to ventral rumen (Hofmann, 1989).

Rumen content stratification is thought to vary between browsing and grazing ruminants (Clauss et al., 2003). Grazing ruminants have a well-defined fibrous mat at the surface of the rumen contents and a more liquid layer beneath. In contrast, browsing ruminants are thought to have more homogenous rumen content with little stratification. As a result of this difference in rumen content stratification, it is reasonable to assume that the rate of passage of fluid and particles out of the rumen would vary between browsing and grazing ruminant species. In fact, the rate of flow of ingesta out of the rumen was greater in browsing ruminant than grazing ruminants (Behrend et al., 2004; Hummel et



al., 2005). As a consequence, it appears that digestible components of the diet are not completely fermented in the rumen of browsing species. This is supported by the fact that glucose transporter expression and carbohydrase activity are substantially greater in the small intestines of browsing ruminants, and similar to that of monogastric species (Rowell-Schafer et al., 2001). Additionally, the polyunsaturated fatty acid (PUFA) content of browsing ruminant tissues is greater than the tissue PUFA level of grazing species (Meyer et al., 1998), demonstrating that browser diets may contain more PUFA and that a larger proportion of the PUFA ingested escapes biohydrogenation in the rumen and is absorbed intact in the small intestine. Because browsing ruminants appear to have a faster rate of passage of particles out of the rumen, it is logical that these animals receive less of their energetic needs from rumen fermentation than do grazing species, with additional energy coming from endogenous enzymatic digestion in the small intestine as well as hindgut fermentation (Gordon and Illius, 1994).

Overall, these differences in wild-type diets, anatomy and physiology of browsing ruminants compared with grazing ruminants strongly suggest the need for different approaches to captive feeding programs. As more data are compiled on the nutrient content of wild-type diets and commercially available diet items, as well as the effect of various feeding programs on health and nutritional status of captive exotic ruminants, feeding programs should be revised and re-evaluated.

**Table 1.** Representative composition of plants, plant components, and feeds that may be consumed by browsing and grazing ruminants (\*Dairy One Forage Library, 6/09; \*\*www.mazuri.com). All data on a dry matter basis.

	Dry Matter	Protein	Fat	Ash	Lignin	NDF <sup>1</sup>	ADF <sup>2</sup>	Sugars	Starch
Legume hay (e.g., alfalfa)	90.9	21.3	2.4	10.6	7.4	38.8	30.3	11.0	1.9
Grass hay*	92.0	10.8	2.5	7.6	6.4	63.2	39.0	12.9	2.3
Leaves*	61.7	16.6	4.1	7.5	10.7	40.9	28	9.7	1.4
Woody plants*	50.5	9.3	2.6	6.7	15.3	67.5	39.3	9.9	2.3
ADF-16**	90.0	18.9	3.8	8.2	NA <sup>3</sup>	29.7	16.7	NA <sup>3</sup>	27.4
ADF-25**	90.0	17.7	3.3	9.2	NA <sup>3</sup>	40.5	27.1	NA <sup>3</sup>	9.7

<sup>1</sup>Neutral Detergent Fiber  
<sup>2</sup>Acid Detergent Fiber  
<sup>3</sup>Not Available

### Feeding and Related Health Survey Results

With several diet-related issues being reported in some zoo browsing ruminants, a survey was designed to gather an overall impression of ruminant feeding practices, management, and potential diet-related health issues in U.S. zoos. The survey was sent to institutional representatives at 127 facilities holding animals of the bovidae and cervidae families and included diet related questions about 25 browsing ruminant species representing various sizes and regions. Each facility answered the questions only for animals they currently held and answers were reported for the entire group of that species, not individually. Responses were received from 41 facilities. The following is a brief summary of information gathered from this questionnaire and used by the participants of this workshop to determine areas needing closer attention and discussion based on trends seen in the received responses. (N=number of herds)

What type of pellet is offered (N=200)?

37.5% of groups are offered ADF-16

25.5% of groups are offered Mazuri® Wild Herbivore

20.5% of groups are offered other pellets; mostly locally milled pellets are similar to ADF-16.

8.5% of groups are offered ADF-25

8.0% of groups are offered Mazuri® Wild Herbivore Plus

What type of hay is offered (N=193)?

- 57.5% of groups are offered alfalfa hay
- 18.7% of groups are offered grass hay
- 18.7% of groups are offered grass/legume mixed hay
- 5.2% of groups are offered other hay types

In what ratio are pellets and hay offered (N=168)?

- 31.0% - 50:50 pellets to hay
- 26.2% - 25:75 pellets to hay
- 14.9% - 66:33 pellets to hay
- 13.1% - 33:66 pellets to hay
- 8.9% - 75:25 pellets to hay
- 4.2% - 100:0 pellets to hay
- 1.8% - 0:100 pellets to hay

How often is browse offered? Do the animals consume the browse?

- 45.8% - As available
- 31.7% - Daily
- 13.4% - 1-2 times per week
- 9.2% - 3-5 times per week
- 90% of groups consume the browse

Are animals group fed or individually fed? How many feedings are offered per day? Are the animals in mixed-species enclosures?

- 63.6% are group fed
- 36.4% are individually fed
- 45.6% are fed twice per day
- 39.8% are fed once per day
- 14.6% are fed 3 or more times per day
- 51% are in mixed species exhibits

What common health issues are seen in your ruminant browser species? (It should be noted that most facilities reported these issues presenting in individuals, not necessarily in all animals within a group)

- 19.3% - Poor body condition
- 18.3% - Diarrhea
- 17.4% - Low weight
- 15.6% - Mineral imbalance
- 11.0% - Ruminant acidosis (diagnosed)
- 9.3% - Inappetence
- 5.5% - Bloat
- 3.7% - Expulsion of rumen contents

## Feeding Recommendations

These recommendations were created based on a combination of the expertise of the academic specialists, the actual experience of some zoo nutritionists feeding these diets, the Nutrient Requirements of Small Ruminants (2007), and the Nutrient Requirements of Beef Cattle (2000). Some values are slightly higher than recommended for small ruminants and/or beef cattle to cover all stages of growth, pregnancy, lactation, and maintenance because zoo animals are typically housed in herds and diets must meet the requirements of all animals in the herd. The recommendations are for the total diet of the animal (pellets, hay, browse) and are listed on a dry matter basis.

**Energy:** Energy requirements for exotic ruminants have sometimes been estimated using a general equation from Robbins (2001) of  $141.4 \text{ kcal metabolizable energy (ME)} \times \text{BWkg}^{0.75}$ . Some browsing species in captive facilities are experiencing decreased body condition, suggesting that previous estimated energy requirements may be too low. Red deer stags have the highest estimated energy requirement at  $203 \text{ kcal ME} \times \text{BWkg}^{0.75}$  (Fennessy et al., 1981), that would include increased energy demands for antler growth. Therefore, to estimate energy needs for browsing species, we recommend



using a mid-point value between Robbins and Fennessy et al. of 175 kcal ME\*BW<sup>0.75</sup>. In addition, the previous recommendations from the GNW called for calories required to be split 50:50 between pellets and hay. However, some browsing species may not be capable of consuming 50% of the caloric needs from hay and may require a larger proportion of their energy from a manufactured feed. With a possible increase in estimated caloric requirements, it is also now recommended that the pellet to hay ratio be increased by offering 50-75% of their calories from pellets and 25-50% of their calories hay, assuming the recommendations listed below are also met.

**Protein:** Recommend a minimum of 14% crude protein, which should support any physiological stage, although this recommendation is likely higher than required for basic maintenance needs.

**Fiber:** Recommend a minimum of 40% neutral detergent fiber (NDF), but for smaller species (< 50 kg) the minimum NDF concentrations may be lowered to 25 – 30% to meet energy needs.

**Starch:** With decreased body condition reported in several species, <10% is recommended, but <7% is encouraged (increased from <5% in GNW).

**Fat:** As a way to compensate for higher energy requirement estimates, without relying too much on starch or simple sugars, we now recommend 4-8% fat (increased from 2-5% in GNW). Due to potential rumen dysfunction, concentrations higher than 8% are not recommended. We also recommend that the diet include a fat source rich in omega-3 fatty acids (e.g., fish oil, flaxseed/linseed).

**Calcium (Ca):** Recommend a minimum of 0.8% for browsing species. A Ca:P ratio equal to or greater than 1.2:1 is suggested.

**Phosphorus (P):** Recommend a minimum of 0.3% for browsing species with a maximum of 0.5%. Hyperphosphatemia and renal failure are common in browsers and seems to be related to dietary P. A Ca:P ratio equal to or greater than 1.2:1 is suggested.

**Magnesium (Mg):** A minimum of 0.3% is recommended.

**Copper (Cu):** The recommended concentration is 10-15 ppm. Some sheep species are sensitive to high concentrations of copper. The Small Ruminant NRC (2007) recommends maximum concentrations of 15 ppm dry matter for sheep if diets contain normal molybdenum (1-2 ppm DM) and sulfur (0.15-0.25%) concentrations (NRC, 2005).

**Sodium (Na):** A minimum of 0.1% is recommended. Free access to a salt block may be desirable, especially if lactating animals are in the group or if the animals are encountering hot weather.

**Vitamin A:** The recommended concentration is 5000-6000 IU (RE) A/kg is ideal with an absolute minimum of 3900 IU (RE) A/kg.

**Vitamin D:** The recommended minimum concentration is 1200 IU D3/kg.

**Vitamin E:** A minimum concentration of 100-150 IU E/kg is recommended for browsing ruminants. While vitamin E is typically found in hay, the concentrations can vary significantly between hay types and cuttings, and thus vitamin E concentrations from hay are typically considered 0 during diet formulation. It is important to find pelleted diets with high vitamin E concentrations that will enable the final diet to meet this recommendation.

## Management Recommendations

To maximize animal health and monitoring, several management recommendations were developed.

1. It is important to identify a low-starch manufactured feed (< 10% starch, preferably < 7% starch) that will meet the needs of the collection when supplemented with hay and browse. If residing in colder climates, a more calorically dense feed may be warranted. To keep starch concentrations low, the increased energy should come from a fat source.

2. It is important to weigh **BOTH** pellets and hay to accurately monitor feed intake. A minimum of one week should be used to measure intake to develop a baseline for each animal/herd. Once baseline measurements are established, monitoring intakes quarterly should be sufficient. During this time, it is imperative that an appropriate amount of pellet is being consumed by each individual. As noted previously, based on the increased caloric intake recommendations, browsing ruminants may need to be consuming 50-75% of their dietary calories as a low-starch, high-fiber pelleted feed. The recommendations from this workshop are very different than previous recommendations for browsing ruminants.

3. Develop more species-specific body condition scoring charts. This assessment along with body weight records would help identify an ideal target body weight on an individual basis and help determine when there may be a health or dietary problem. Assessing the body condition of each individual and recording this information in writing and with a photo would establish baseline information for the animal and would make changes in body condition easier to identify.

4. Establish a testing protocol and a testing schedule for both hay and pellets to monitor for nutrient changes. Periods of excessive rain, drought, and time of year hay was harvested can significantly impact the nutritional quality of the hay being offered. If poor-quality hay is being offered, dietary changes can be temporarily implemented until hay conditions improve. There are several feed testing facilities available; Dairy One Forage Testing Laboratory ([www.dairystone.com](http://www.dairystone.com)) or Midwest Laboratories ([www.midwestlabs.com](http://www.midwestlabs.com)) are commonly used facilities. A local agricultural extension office can also assist in finding analytical services. Analyses should include moisture, crude protein, acid detergent fiber, neutral detergent fiber, and minerals (calcium, phosphorus, magnesium, potassium, sodium, iron, zinc, copper, manganese, and molybdenum). Additional minerals can be quantified if necessary. Building a feed analyses database at an institution will prove to be a useful tool. When hay is purchased from selenium deficient areas, quantifying the selenium concentration in the hay is strongly encouraged.

5. When formulating diets, it is important to quantify the amount of all foods offered, including produce, and recognize it as part of the standard diet. Although typically minimal, these items will add caloric value to the diet and may result in decreased consumption of pellets and hay.

6. Although it is difficult to quantify the amount of browse offered and consumed, it is important to feed browse to browsing ruminants as often as possible. When browse is not available, offer hay. One or both of these should be available at all times to browsing ruminants. It is also important to ensure that individual animals do not minimize pellet consumption because of a preference for hay or browse. Careful and repeated observations of the eating and activity patterns are needed for animals that seem to be having problems maintaining body condition.

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# Practical Considerations for Restraint of Hoofed Mammals in a Small Zoo

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## Introduction

Hoofed mammal restraint (HMR) is performed with a variety of methods throughout North American zoos today. The methods used are determined by the history, design and the experience of staff. Most zoos have used or continue to use some form of stall capture, or a combination of stall capture and mechanisms that cause an animal to be restricted in space to facilitate hands-on capture. These methods are still useful today, especially with smaller specimens of notable agility. In some cases stall capture with chemical restraint methods are commonly used because a zoo has no other built-in tool to do otherwise. Many of our zoo's hoofed mammal exhibits were not designed with the room or forethought to be able to add restraint devices other than stall capture.

Over the last 30-odd years zoos have begun to incorporate chutes or alleyways into their ungulate areas. The commercial deer and bison farm industry have helped develop a number of manual and hydraulic restraint devices applicable to our animals. And today several companies specialize in creating safe restraint devices for zoo animals.

Recently state and sometimes federal regulations have dictated the need for annual health screening tests of ungulates. This can be a difficult procedure when zoos have several animals of any species. As more health conditions come to light (e.g. chronic wasting disease in cervids), the more zoos will need to comply with monitoring regulations. Many animal health-testing regimens can be accomplished by device-assisted restraint. And this is all to the good. While chemical immobilization will always be needed in some cases, for many routine tests we just cannot afford the increasing drug costs associated with chemical immobilization or the time involved.

Set forth here are a few practices that we have initiated at the Rosamond Gifford Zoo to assist us in monitoring the health and welfare of our small collection of hoofed mammals. Every zoo will, of course, have its own situation to take into account, but perhaps a few zoos may be able to apply our experiences to their own circumstances.

## Some Basics

Know your animal. This cannot be over emphasized. However we approach HMR, we need to consider our understanding of the behavior of the species and the individual animal in the design and operation of whatever restraint system we are using.

Most but not all hoofed mammals are herd animals with a strong herd bond. If animals are to be conditioned prior to restraint (preferred), we can use the herd instinct to our advantage. The drive to be together, especially during stress, can be applied if moving the group through a capture area or chute. We can reduce the stress on individuals if a herd can be moved as a group, or at least in subgroups. And repetition, using "practice runs" through the capture area, can help to reduce stress and prepare animals best for their annual testing.

The stress of movement may also be reduced by control of light and direction. Some species may move more easily if there are turns or bends in the chute. Others may move more easily if the chute is darkened, or even if the chute is darkened above, while having open light at the end: the proverbial "light at the end of the tunnel" effect. Once an animal reaches the restraint device, we can minimize the stress on the restrained animal by covering its eyes; maybe gauze ear plugs in the ears, or other tricks that can minimize the sensory experience or divert the animals' attention.

The incorporation of a handling system can often be a deciding factor in a zoo's choice of hoofed

mammal species. Handling systems require room to build or attach them, and this can be a problem if space is at a premium.

The following are some examples of restraint or handling methods used at the Rosamond Gifford Zoo from 1996 to the present:

### Cattle

In the recent past the RGZ has held both yak (*Bos grunniens*) and American bison (*Bison bison*) until exhibits were changed. Both species are considered protected contact or shielded contact in most zoos because of their potential dangerous nature. As a group, cattle, and certainly bison and yak, are very herd-bonded animals and do not like being separated. The best handling situation for such large animals is a chute system that is designed into the animals' holding and exhibit in such a way that the animals must pass through the chute to access either. In this scenario, after going through the chute to the exhibit the animals are rewarded by going "home". Or, in the reverse, animals can acquire their favorite food items by going through the chute to enter holding.

We have had chute systems in place for these species for some years. For the bison, a handling device, the J.K. Reid Bison Squeeze™, was incorporated into the chute. Once in the chute, individual animals or subgroups can be separated into different sections by sliding doors. Each animal can then wait its turn until it is moved into the squeeze area. In our experience, most cattle are fairly calm once separated into a chute section. This is especially true the darker the area can be made. Once in the squeeze and properly secured, we have been able to do most annual testing on both female and male bison. Like any restraint device used for large animals, it is only as good as your method for getting the animal into it.

Modern commercial systems for bison farms have everything a herd manager would need to move bison in total protected contact. Most of these systems incorporate a "turning tub" into their design: a movable solid gate that crowds the bison into the beginning of the chute hallway. Lacking such a feature, we fall back on conditioning the animals to move through the chute willingly. Again, this is best done by using the chute as an access to a reward, whether food in the chute or access to where the animal(s) wants to be. While it is certainly possible to drive cattle into the chute with enough people and shields, it can be a dangerous operation for the inexperienced. As stated earlier, if the animals are conditioned to see the chute as a means to get on exhibit, their tendency will be to enter it if pressured.

The yak is a slightly less dangerous species than bison. Having been domesticated for years, many yak are readily trained to a halter if started when young. The females that were held at the RGZ were never trained to a halter, but were conditioned by keepers to move through the chute by feeding within it or immediately upon leaving. The working section of the yak chute is a section that allowed zoo workers to access the animals through the protection of iron bars (Figure 1).



Once within a closed section of the chute, keepers were able to reduce the animal space with another gate, making it easier to give injections and treatments. Eventually, however, keepers found they got just as much success by conditioning the animals to stand fairly still. Keepers would "pet" the animals to get them used to be touched by the veterinarians, while feeding the yak its favorite treat item in the chute section. The yak eventually accepted going through the chute regularly to receive insecticide applications as well.

**Figure 1.** Veterinarians performing annual exam on a female yak, 2006. By feeding and repetitive contact in the area, the yak was conditioned to accept treatment. (Photo: RGZ 2006)



Large Deer

Like cattle, deer have a strong herd behavior, but the similarity ends there. Deer are far more agile and seem far more acutely aware of the changes around them. In general, cattle rely on size and power as a defense, while deer are more flighty and very reactive to noises and movements. At the RGZ we have had a long history with at least four species: Whitetail deer (*Odocoileus virginianus*), Wapiti (*Cervus canadensis*), Reindeer (*Rangifer tarandus*) and White-lipped deer (*Przewalskium albirostris*). Currently we only house the latter two species and will concentrate on them.

The white-lipped deer is somewhat similar to wapiti in size and behavior, but in general we have found them to be far more aggressive in our setting. Any male deer in the rut season is a particularly dangerous animal to deal with; but male deer that have had been conditioned to be around keepers are even more dangerous. For this reason we do our annual testing for white-lipped deer at different times. We perform our testing on the male in the spring after he has lost his antlers, (Figure 2), and we perform our testing on the females and young in the fall after parturition season is over.

Certainly there are deer farms that perform testing on male deer throughout the year. And in the past we have done young antlered wapiti in our chute and restraint. However, the white-lipped deer male has a very wide set of antlers. Even if we were able to condition a male in rut through the restraint system, the antlers would never fit.

Our restraint system for the white-lipped deer consists of a chute that runs between two holding areas, with a Fauna Research Tamer®, a manual drop floor restraint, at the end. Animals can be conditioned to accept the chute by allowing them access through it between the two holdings areas. Animals are fed daily in the holding areas.

It is not hard to get the male into a chute area once his antlers are dropped. Several people with shield boards are able to pressure the male by reducing his space in the holding until he decides to move through the system. However, we do not anticipate that every male is going to exhibit such behavior. A safer practice is to condition the male to move through the chute to access food as in the above example. We have used both methods with success.



**Figure 2.** White-lipped deer male, not long after losing the last set of antlers, being restrained for annual physical and hoof trimming. (Photo: RGZ 2010)



**Figure 3a.** White-lipped deer male showing antlers too wide for Tamer®. **Figure 3b.** Still in use, a ten-year-old Tamer® is shown attached to the chute system between WL Deer holdings. (Photos: RGZ 2010)





With females, which are moved as subgroups, the behavior is much more acutely towards the flight side of the equation. These animals are best moved in small groups, and are best conditioned over time to accept the chute to reduce stress. Too much stress on unconditioned animals can sometimes lead to capture myopathy.

In the fall we condition female deer to the idea of moving by running the group through the chute and Tamer® in a non-capture mode a few times, perhaps once a week, for three to four weeks prior to capture. Even under the best of circumstances, some females will get very nervous and start turning inside the chute sections, or worse, will stall in a particular space. We always try to minimize the capture time, especially for animals that we know are going to be very nervous. Conditioning can prepare animals and prevent these behaviors.

The RGZ has had a collection of reindeer since its reopening in 1986. While we have only had a few in recent history, many zoos enjoy working with the semi-domesticated reindeer because of their overall easy nature and their public appeal. However, even well-trained reindeer or human-socialized reindeer can turn dangerous under certain conditions. Males in rut should never be trusted, and males that have been hand-reared are almost always dangerous. Even hand-reared and haltered female reindeer cannot be fully trusted. Some human-socialized reindeer are good with everybody; others are good with only one or two people. There does not seem to be a set rule, or a reliable prediction of how "tamed" reindeer will act. Certainly the most predictable course is to work only with mother-raised "wild" reindeer.

Reindeer tend to do better in groups. There are private reindeer farms from Alabama to Alaska, and most take a hands-on approach to handling these animals. Because of their (relatively) smaller size, most zoos still manually restrain their reindeer in stalls. But they are easily worked in both chute systems and with a drop floor restraint as well. Our reindeer inherited the former yak yard and its chute system. This chute system runs between two holdings and out to the exhibit, so the animals easily see it as a means to get from point A to point B. While the system can be altered to hold a Tamer® device, we have found it easier just to hand-restrain reindeer inside the chute sections for all kinds of operations and hoof trimming. We restrain the more dangerous reindeer by a number of people holding them from outside the iron bars of the working section.

### Caprines

Caprines, the wild sheep and goats, pose some interesting challenges for restraint. The RGZ has over the years held Rocky Mountain goats (*Oreamnos americanus*), musk-ox (*Ovibos moschatus*), big horned sheep (*Ovis canadensis*) and Tajik markhor (*Capra falconeri heptneri*). In the past the Rocky Mountain goats were almost always handled through stall capture and restraint, which was the only course available to us at that time. The large and dangerous musk ox was worked exclusively through chemical immobilization, long before we built any restraint systems. We will concentrate here on our recent experience with the wild sheep and goats.

All Caprines are known for their agility. This makes stall capture and restraint potentially dangerous for the animals. These operations are best handled in stalls or small holding areas with low ceilings. As with other HMR the best design for a restraint chute is one that the animals can pass through regularly, on a daily basis if possible. Our chute for markhor and bighorn is a short one between two holding areas (Figure 4). The markhor regularly use it to access holding areas.



**Figure 4.** Interior of chute system between markhor holding areas. Note the ceiling barrier for agile animals. (Photo: RGZ 2009)

The HMR design for wild sheep and goats does not include any squeeze mechanism; it merely reduces the space in which animals can move once they are sectioned off into individual areas. The top of the chute is covered to prevent animals from climbing higher than 5.5ft. [1.67m] up any side. A "working section" (Figure 5) of the chute is in the middle. It allows keepers to move animals from either side of the chute into it. Access doors are located to the rear and front of the section, allowing keepers to enter the chute to work with the animals.





**Figure 5.** The working section of the markhor chute. Keepers manually restrain the animal in this section. The plywood doors (lower door open) allows Animal Health staff access.

(Photo: RGZ 2010)

Markhor and wild sheep require extreme care once the herd or subgroup is moved into a holding. Exterior holdings, if not covered, need overhangs to prevent escape. Even a 210lb. markhor male can climb out of a 10 ft. straight fence if under stress. The key again is to know the individuals. There are some markhor with a reputation as escape artists and in most of these cases they are individuals who seem extremely stress sensitive. Such individuals we have found are best kept in a subgroup or herd and not separated prior to moving them in the chute.

It is useful with agile animals to have burlap or other such material coverings the mesh of holdings, as under stress these animals can forget barrier locations. Several keepers (usually three to five) move into holdings to pressure animals towards the chute entrance, while two or three keepers operate remote doors on the outside of the chute. The person

in charge coordinates the keepers who form a line to pressure the herd or animal toward the chute, and alerts the door operators when the herd is entering. It must be stressed that the keepers pressuring the animals towards the chute are coordinated slowly, move as a group, and listen to the one in charge. Since the animals in questions have almost always had experience going through the chute, their natural flight instinct tells them that this is the way out.

Once in the chute, keepers on the outside divide animals into sections. This allows keepers to select individuals, and move a particular animal to the "working section" located in the middle of the chute. The non-selected animals may be waiting in another section of the chute, or released to other holdings. From this point the capture and restraint of the goat or sheep is done manually, but in the safety of a confined space where the animal can be manually restrained with little latitude to move or hurt itself.

## Guanaco

Our experience with guanaco (*Lama guanicoe*) is limited to a bachelor herd of males. We have used the Tamer® with guanaco with good success, but for regular procedures we found a squeeze gate system to be simpler.



**Figure 6a.** Guanaco holding showing gate wall attached to holding (gate section removed).(RGZ 2009)



**Figure 6b.** Guanaco squeeze gate in place. (RGZ 2011)

Our guanaco have been very easy to work around, which is perhaps not the experience at other facilities. But we have found it fairly easy to drive guanaco from one holding to another or into stalls for separation. Once separated, individual guanaco can be restrained manually by capturing the animal into a squeeze gate, (Figure 6 a & b). The squeeze gate is a modified cattle gate. The gate is lifted and pushed by two keepers, and the animal is pressed against the back wall. The squeeze section has a six-foot ceiling on it to prevent the animal from jumping or climbing up, a common

reaction from a guanaco when trying to restrain it. Another keeper grabs the neck and head of the animal to hold it steady while the others are pressuring it. The guanaco thus stabilized, allows Animal Health staff time to examine cuts or give injections.

### Summary

There are many ways to accomplish HMR in the zoological setting. Even the smallest zoo can do more in this area given the right ideas. The following are a few principles that we believe could be helpful in most situations:

1. HMR is a team effort. The person in charge of restraint should have a brief meeting prior to restraint, and everyone should be familiar with his or her role and responsibility.
2. Equipment needs regular maintenance, and all working parts need to be checked before the operation. Hoofed mammals can be hard on equipment, and last thing you need is a mishap during the operation.
3. Good holding areas or shelter stalls are essential for establishing HMR routines for the animals. Zookeepers should feed some portion of the animals' daily intake in holdings and other areas so that they become comfortable moving from point A to point B. Animals should be rewarded with enrichment foods for moving through the area.
4. Chute systems are best if they exit to another holding or to the exhibit.
5. Depending on the species, some chute system designs are best if they have turns, or are darkened from light coming from above. Agile animals will need to have chutes that restrict space more, and have a ceiling barrier.
6. Whenever possible establish a regular routine for animals to move through chutes and/or holdings. Routine leads to less stress.
7. Work towards minimizing capture and restraint time. Break up large groups into subgroups. Do not allow unconditioned animals to endure stress locations for long periods as this might lead to capture myopathy.
8. Remember that any large animals that have been hand-reared, or animals that have had over exposure to keepers (e.g. treated as a "pet"), or even animals mother-raised by a hand-reared dam, may be more dangerous and unpredictable than their "wild" counterparts.

9. Cover the eyes of animals during restraint. Depending on the species, this is essential for those animals more prone to stress.

10. Observe and monitor released animals following restraint.


### Acknowledgement

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### Products Mentioned In Text

JK Reid Bison Squeeze™: JK Reid Bison Equipment, JK Reid Manufacturing & Sales, 7647 Wellington County Road 10, R.R. #1, Moorefield, Ontario, Canada N0G 2K0.

The Tamer®: Fauna Research, Inc., 8 Bard Avenue, Red Hook, New York, USA 12571-1108.



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# Inventing the Wheel:

## Hand-Rearing a Single Babirusa (*Babyrousa babyrussa*)

By Nicole Piepers, Nursery Keeper  
Los Angeles Zoo and Botanical Gardens, Los Angeles, CA

### Introduction

On 20 May 2010, 1.0 babirusa piglet was pulled for hand-rearing due to low body temperature, weakness, small (runt) size and consequent inability to nurse. 1.0 babirusa piglet (littermate) was left with dam, as he was doing fine. There was some discussion of pulling both piglets for hand-rearing, since pigs, in general, tend to do better when hand-reared with a conspecific than not. However, due to our inexperience hand-rearing babirusa, it was decided not to do this. In fact, we discovered that, in general, very few babirusas have been hand-reared successfully to maturity. In our research, we found only one documented case in *The International Zoo News* Vol. 47/1 (No. 298). The paper was titled "The Growth and Development of Two Hand-reared Babirusa at Port Lympne Wild Animal Park" by Robert Saville and Matt Hartley. The paper describes the management of two male babirusa that were born on 13 December 1996. Later that day, they were taken for hand-rearing due to the failure of the dam to rear previous litters and the risk of infanticide. The piglets weighed 600grams (infant A) and 400grams (infant B). They were hand-reared by Robert Saville.

Quoting from article: "Due to the lack of published information on artificial diets for babirusa, a protocol used for hand-rearing domestic swine was adopted (by Port Lympne). Initially, the infants were each fed 2ml of Volostrum (commercial pig colostrum substitute) at two-hourly intervals. On the third occasion this was combined with 7ml of Volac Farmamate milk replacer. This was continued through the night at two-hourly intervals. Human infant bottles and teats were used. After a total of ten feeds (20ml) of colostrum substitute had been administered, only the milk replacer was fed. At five days old, an ad lib. Feeding protocol was adopted, with bottle feeds being reduced to three-hourly intervals. The frequency of feeds was reduced as intake increased."

The paper was not very comprehensive, and did not specify feeding times, amount of feeds per day, when formula increases were made or feeding techniques. The animals were weaned very early, at six weeks of age over four days, much earlier than maternally raised babirusa, which wean at about six months of age. We decided not to follow this protocol due to the limited amount of information it provided. We also did not have any domestic swine formulas in stock nor did we have a source for them. We opted instead to model a protocol loosely based on our experience with warthogs and red-river hogs.

### Nursery Data: 1.0 Babirusa (*Babyrousa babyrussa*) "Homer"

**Birth Date:** 05-20-2010

**Date pulled:** 05-21-2010

**Weight:** 423 grams [14.92 oz.]

**Body temperature:** 96.1°F [35.6°C]

(normal is between 100-101°F) [37.78-38.33°C]

**Treatment:** umbilicus dipped in Betadine®

Continued this treatment 2x daily until Day 12

**Incubator temperature:** 80-85°F [26.7-29.4°C]

**Formula (initial):** cow's colostrum

**Formula (final):** Meyenberg evaporated goat's milk 1:1 water

**Nipple type (initial):** Pritchard's flutter valve

**Nipple type (final):** Evenflo® preemie nipple (with hole enlarged)

**Initial amt. formula offered:** 15ml every two hours for eight feeds (28% body weight)



Day 1 - Homer in incubator

**Feeding technique:** Did not enjoy being held or handled while feeding. Did best on ground with something to step up on, so angle of bottle was appropriate.

**Housing:** Housed in a stainless steel incubator until 13 days of age. Piglet was provided with a stuffed animal toy and several towels for security. Incubator temperature was kept between 80-85°F. Temperature was decreased by 10°F at six days of age.

At 13 days of age, piglet was moved to a small stall equipped with hanging heat lamp. Stall was bedded with clean towels over a layer of grass hay over a layer of wood shavings. Towels were used to more easily determine urine and fecal output and to deter ingestion of natural substrate. Moved to a larger stall bedded with wood shavings on Day 47.



Homer on Day 2

### **Diet Record/Feeding Schedule:**

Day 1: 15ml (28% BW) cow's colostrum, 8x daily (every two hours), ribbed nipple.

Days 1-3: As of 4th feeding on Day 1: 15ml cow's colostrum 1:3 evaporated goat's milk 1:1 water, 8x daily (every 2 hours), switched to flutter valve nipple.

Days 4-6: 18ml (28% BW) cow's colostrum 1:3 evaporated goat's milk 1:1 water, 8x daily (every two hours)

Days 7-9: 21ml (23% BW) cow's colostrum 1:3 evaporated goat's milk 1:1 water 8x daily (every two hours). Add 1 pinch Probios™ granules to each bottle.

Days 10-12: 25ml (23% BW) cow's colostrum 1:3 evaporated goat's milk 1:1 water, 8x daily (every two hours). Add 1 pinch Probios™ granules to each bottle.

**NOTE:** Now offering small amount banana from finger.

Days 13-15: 30ml (24% BW) cow's colostrum 1:3 evaporated goat's milk 1:1 water, 8x daily (every two hours). Add 1 pinch Probios™ granules to each bottle.

**NOTE:** Now offering small amount porcine grower pellets (soaked).

Days 16-18: 35ml (24% BW) cow's colostrum 1:3 evaporated goat's milk 1:1 water, 8x daily (every two hours). Add 1 pinch Probios™ granules to each bottle.

Days 19-21: 40ml (24% BW) cow's colostrum 1:3 evaporated goat's milk 1:1 water, 8x daily (every two hours). Add 1 pinch Probios™ granules to each bottle.

**NOTE:** Day 20- Now offering small amount of greens (swiss chard, kale, collard greens).

Day 24- Added raw yam to diet.

Days 22-24: 50ml (23% BW) evaporated goat's milk 1:1 water, 7x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

Days 25-27: 60 ml (26% BW) evaporated goat's milk 1:1 water, 7x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

**NOTE:** Small amount of carrot added to diet.



Days 28-30: 75ml (31% BW) evaporated goat's milk 1:1 water, 7x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

Days 30-32: 80ml (29% BW) evaporated goat's milk 1:1 water, 7x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

**NOTE:** Due to insufficient weight gain, gradually transitioning over four days to a more concentrated formula: evaporated goat's milk 2:1 water. Also now offering free-choice alfalfa.

Day 33: 80ml (27% BW) evaporated goat's milk 2:1 water 1:3 evaporated goat's milk 1:1 water, 7x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

Day 34: 100ml (29% BW) evaporated goat's milk 2:1 water 1:3 evaporated goat's milk 1:1 water, 6x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

Day 34: 100ml (29% BW) evaporated goat's milk 2:1 water 1:1 evaporated goat's milk 1:1 water, 6x daily (every three hours). Add 1 pinch Probios™ granules to each bottle. Switched to Evenflo® preemie nipple to slow flow of formula.

Day 35: 100ml (29% BW) evaporated goat's milk 2:1 water 3:1 evaporated goat's milk 1:1 water, 6x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

Day 36: 100ml (27% BW) evaporated goat's milk 2:1 water, 6x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

Days 37-46: 120ml (30% BW) evaporated goat's milk 2:1 water, 6x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

**NOTE:** Now offering produce in a.m. and p.m

Days 47-59: 140ml (24% BW) evaporated goat's milk 2:1 water, 6x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

Days 60-65: 140 ml (14%BW) evaporated goat's milk 2:1 water, 5x daily (every three hours). Add 1 pinch Probios™ granules to each bottle.

**NOTE:** Now offering Mazuri® ADF-25 herbivore pellets in addition to Mazuri® porcine grower.

Days 66-75: 170ml (16% BW) evaporated goat's milk 2:1 water, 5x daily (about every four hours). Add 1 pinch Probios™ granules to each bottle. Also adding ½ tsp. ground porcine pellets to each bottle (not consuming solids)

**NOTE:** To encourage weight gain, increased formula amt. to what was being offered at six feeds/day. Feeding times also spread out. Also offering some melon in a.m. food tub to encourage consumption of solids.

Days 76-93: Same as above except increased ground porcine pellets to 1tsp. per feeding.

**NOTE:** Adding ½ hardboiled egg to pellet gruel (mixed) in to encourage consumption. As of Day 83, offering some apple. As of Day 86, offering pear.

Days 94-132: Same as above except increased ground porcine pellets to 2tsp. per feeding.

Days 133-137: Same as above except increased ground porcine pellets to 3tsp. per feeding.

**NOTE:** Mixing pear flavored baby food in with pellets and grating carrots and yam to encourage consumption of solids.

Days 138-151: Same as above but now offering formula in a crock instead of a bottle. Also increasing porcine pellets mixed into milk over time.

Days 152-158: 220ml (6% BW) evaporated goat's milk 2:1 water 3x daily (every six hours). Add 1 pinch Probios™ granules to each bottle. Also adding 3-4 tsp. ground porcine pellets to each feeding. Offering in a small rubber tub with two handfuls whole porcine pellets. Baby food mixed in for flavor.

**NOTE:** Feeding produce now in large black tub with scoop of whole porcine grower pellets and handful ADF-25.

Days 159-165: Same as above but now 2x daily (0900 & 1500hrs).

Days 166-193: Same as above but now only 1x daily (0900hrs).

Day 194: Weaned.

**NOTE:** We were planning on weaning at 180 days old, but held off due to insufficient weight gain and consumption of solids.

## Weights

Day 1 = 423g  
Day 2 = 442g  
Day 3 = 475g  
Day 4 = 526g  
Day 5 = 591g  
Day 6 = 672g  
Day 7 = 731g  
Day 8 = 777g  
Day 9 = 811g  
Day 10 = 853g  
Day 11 = 898g  
Day 12 = 939g  
Day 13 = 997g  
Day 14 = 1.37Kg  
Day 15 = 1.10Kg  
Day 16 = 1.15Kg  
Day 17 = 1.25Kg  
Day 18 = 1.30Kg

Day 19 = 1.35Kg  
Day 20 = 1.40Kg  
Day 21 = 1.40Kg  
Day 22 = 1.50Kg  
Day 23 = 1.50Kg  
Day 24 = 1.55Kg  
Day 25 = 1.60Kg  
Day 26 = 1.60Kg  
Day 27 = 1.65Kg  
Day 28 = 1.70Kg  
Day 29 = 1.75Kg  
Day 30 = 1.85Kg

### WEEKLY

Day 37 = 2.40Kg  
Day 44 = 3.25Kg  
Day 51 = 3.95Kg  
Day 58 = 4.65Kg

Day 65 = 5.15Kg  
Day 72 = 5.80Kg  
Day 79 = 6.35Kg  
Day 86 = 6.80Kg  
Day 93 = 7.15Kg  
Day 100 = 7.55Kg  
Day 107 = 8.00Kg  
Day 114 = 8.50Kg  
Day 121 = 9.10Kg  
Day 128 = 9.40Kg  
Day 135 = 10.15Kg  
Day 142 = 10.65Kg  
Day 149 = 11.25Kg

### ~MONTHLY

Day 179 = 14.3Kg  
Day 215 = 15.4Kg  
(littermate was 16.6Kg)



Homer taking a bottle at three months of age





Homer bothering the tufted deer fawn  
at 2 1/2 months old.

with him daily to fulfill his social requirement somewhat, but this did not help him to eat solid food.

At this point, we discussed the possibility of reintroducing "Homer" to his family and continuing to hand-rear him at the exhibit. We thought that this option would possibly ensure better social development and encourage consumption of solid foods.

At two months of age, we brought "Homer" up to the babirusa exhibit to howdy with his mother and brother. Mother and brother were locked into an annex yard, and "Homer" was given run of the exhibit. "Homer" was more rinterested in the keepers in the area. Mother exhibited aggressive behavior if "Homer" came near her fence. Brother was fixated on staying with mom and not at all interested in the newcomer. We continued introductions in the same manner over the next few days, once daily for about 30 minutes at a time. We decided that we would not physically introduce "Homer" to his mother due to the

## Social Concerns

This animal probably would have thrived more if reared along with a littermate. We tried integrating him with our other infant ungulates - tufted deer [*Elaphodus cephalophus*] and red flanked duikers [*Cephalophus rutilatus*] in the nursery yard. This was deemed unsuccessful after a few sessions, as he got in the habit of chasing and jumping on them, subsequently stressing them out, the tufted deer in particular. From then on, he had to be kept alone in a separate yard. He did however have visual access to the other animals through a chain link fence during this time. He seemed to pick up on eating browse from the deer and duikers. He particularly enjoyed mulberry, natal plum and kaffir plum. Keepers made sure to spend time



Homer eating mulberry leaves at 2 1/2 months old.



Homer is introduced to his mother at ~3 months

time with similar results. The next time, we tried this same set-up but without keepers in the yard (keepers were positioned at the patron viewing side of the exhibit). The sibling actively avoided "Homer" (afraid of him). "Homer" was pacing the perimeter fence and searching for keepers. He vocalized for keepers and this seemed to wind up mom. We tried this again the next day with similar results. At this point, we decided to suspend intros due to some safety concerns (potential breach under annex yard fence) and the brother's separation anxiety from mom.

aggressive behavior she was exhibiting during the howdy period. After about a week, we physically introduced "Homer" to his brother in the main exhibit yard while mother was locked in annex yard. Keepers stayed in the yard to supervise. "Homer" was again more interested in the keepers. Brother was somewhat panicked that he was separated from mom, and paced the annex yard fence. At one point the two brothers made eye contact, and "Homer" charged at his sibling with open mouth, one ear back and one ear forward. He then turned around, and, full of himself, trotted back to keepers. We did this for three days in a row for about 30 minutes each



When both piglets were four months old, we resumed introductions, not only to dam and brother, but to half sister as well. "Homer's" half-sister was only a few months older and more independent. We thought they might get along. This time, we were leaving "Homer" to the exhibit for the day, with him in the annex yard and the babirusa family in the exhibit yard. The pig keeper would check on them regularly and the nursery keepers would come back to the exhibit for scheduled bottle feedings only. He was transported back to the nursery at the end of the day. We continued this daily. About two weeks later, he was physically introduced to his half sister in the main exhibit yard. Two keepers were present in the yard with them. Shovels, net and baffle board were placed nearby in case the keepers needed to intervene. Several bouts of half-sister chasing "Homer" occurred. One time she pinned him down, and was biting him. Both were very vocal during this. Keeper had to separate them. "Homer" was actively trying to avoid his half-sister, jumping up on log structures or trying to hide between the nursery keeper's legs. This intro lasted about 30 minutes until it was aborted.

Since the introduction with his half-sister did not go very well, we decided against trying it again. Now our plan was to continue as before, bringing "Homer" to the exhibit for the day, to be in the annex yard adjacent to his family. This continued for one month. "Homer" was now five months old. We decided to move him to the exhibit at this time. The howdy set up continued until both "Homer" and his brother were weaned. It had been arranged that both of them would go to San Diego Zoo together, and it was decided that they should be physically introduced there, while in quarantine. We thought that it would work out better if they were properly introduced on neutral territory without the presence of their mother. They both shipped out on 20 January 2011 at eight months of age.

Their introduction went well, and they currently share an exhibit at San Diego Zoo.

### **In Conclusion**

This was our first experience hand-rearing a babirusa. It was a successful first effort, but may require some adjusting if reattempted in the future. Although the mother-reared piglet was not weighed regularly, his body condition was good and "Homer", in comparison, was always smaller and thinner looking. He caught up later though. At seven months of age, they were close weightwise. "Homer" was 15.5Kg and "Jethro" was 16.6Kg. "Homer's" skin was duller in color, dry and less supple compared to "Jethro's". This could have been a genetic defect, or perhaps we were missing a supplement or something else in our rearing plan. At any rate, this protocol is offered to the zoo world as a starting point for hand-rearing babirusa.



Homer enjoys some quality time with the keepers during his hand-rearing in the Nursery at the Los Angeles Zoo.

*All photos provided by the author.*



# Here There Be Dragons: Okapi Conservation in Africa's Equatorial Forest

By Steve Shurter, Director of Conservation  
White Oak Conservation Center, Yulee, FL

Truly untamed places are becoming more rare in this age of technological advancement and instant worldwide communication. The Ituri Forest in the Democratic Republic of the Congo (DRC) is home to the endemic okapi, and is one of the most remote places on earth. The Okapi Conservation Project has been partnering with AZA zoos for more than two decades to conserve the okapi in one of the "wildest" forests in Africa.

Early cartographers portrayed unknown areas of the world under the mantle, *Hic sunt dracones*, Here There Be Dragons. By the late 19<sup>th</sup> century the equatorial forests of Africa were still virtually unexplored when Sir Henry Morton Stanley and his retinue traveled the Congo River in 1886. Stanley's chronicles of their perilous trek through the Ituri Forest included details on the tribes, flora and fauna they encountered. He also wrote of meeting pygmies who, upon seeing Stanley's pack donkeys, described a horse that lived in the forest. We now know that the okapi is a most unique species of forest giraffe (*Okapia johnstoni*), and that the Ituri is one of the most biologically diverse forests in Africa.

The incredible story of the okapi has been partially unraveled since it was first described by western science in 1902, when Sir Harry Johnston sent the first skins and skulls to the London Museum. The forest eventually became the destination for a number of scientific collecting expeditions while the region was under Belgian colonial rule, and the Epulu Okapi Capture Station was established in the late 1940's to provide okapi for zoos of the world. To this day there is great interest to learn more about the mysteries of the Ituri Forest, and to safeguard its wildlife.

We know now that the rainforests of the tropics are important reserves for the earth's biodiversity. The Ituri Forest (175,000 km<sup>2</sup>) of the upper Congo River basin contains diverse plant and animal communities including the okapi. Other species found there include chimpanzees (*Pan troglodytes*) and 12 other species of primates; forest elephants (*Loxodonta cyclotis*), duikers (*Cephalophus sp.*), bongo (*Tragelaphus euryceros*), giant forest hogs (*Hylochoerus meinertzhageni*) and the secretive aquatic genet (*Genetta piscivora*).

The Okapi Conservation Project (OCP) was established in 1987 working in partnership with the Institute in Congo for the Conservation of Nature to protect the forest and wildlife. In 1992 the 13,760 km<sup>2</sup> Okapi Wildlife Reserve was created and in 1996 it was declared a World Heritage Site in recognition of the unique cultural and natural heritage of the region.

Working in the DRC can be challenging due to years of civil unrest and the resulting social and economic challenges for this poor country, now with only basic infrastructure. In addition to protecting the 4000-6000 okapi and other wildlife living in the Okapi Wildlife Reserve, the OCP programs include conservation education, community assistance, training and alternative livelihoods. The Project works closely with local communities and encourages them to become stewards of their forest and natural heritage. Dedicated Congolese staff based at our headquarters in Epulu works tirelessly to implement the programs and achieve the OCP goals, realizing the important long-term forest conservation benefits to their country, and to the rest of the world.

The Okapi Conservation Project has had a strong connection with the Okapi SSP® through our okapi

ambassador program at White Oak Conservation Center. Okapi are produced for participating zoos in the Okapi SSP®, and worldwide, to augment the captive program. When the Okapi Conservation Project was started in 1987 there were six zoos and 21 okapi in the Okapi SSP®, currently there are 26 holders and nearly 90 okapi in the U.S. program. This partnership also provides critical support for the OCP, as Okapi SSP® and Okapi European Endangered Species Programme (EEP) participants channel funds for the Project's work to conserve the okapi and the Ituri Forest.

Despite decades of important work, many “dragons” still exist in the Ituri Forest, although today's unknowns are not myths, but actual threats to the okapi and the region's rich natural resources. The Ituri region has historically included a small population of subsistence farmers, but the population is now increasing with immigrants from other regions, practicing destructive slash and burn agriculture techniques. Traditional hunter-gatherers are being replaced with poachers armed with automatic weapons and steel snares. Miners searching for gold, coltan and diamonds use destructive techniques that damage the forest and pollute river systems. The OCP programs must continually adapt to the changes in the DR Congo and directly address the threats, seeking practical solutions to wildlife and forest conservation in the DR Congo.



The highly endangered Okapi (Photo: S. Rutan)

The future of the okapi and the Ituri Forest is tied directly to the OCP partnership with the zoo community. The okapi ambassadors in zoos around the world enlighten people about this mysterious rainforest giraffe, and this wildest of places on earth. Passionate people, okapi keepers, educators, and park rangers dedicate their lives to saving the okapi and inspire people to take action. Thanks to the gracious support of partners, the Okapi Conservation Project will continue to dispel the dragons in the coming decades, and beyond.

## MOVING?

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# Zoo Atlanta's Hoofstock Enrichment Program

By Nichole Bouwens, Senior Keeper  
Zoo Atlanta, Atlanta, GA

At Zoo Atlanta we have an enrichment program for our hoofstock in which every animal receives enrichment of some type daily. Examples of what our animals receive are categorized by scent (perfumes, spices, colognes, and extracts), object (novel feeders, new furniture, toys), audio (various nature sounds or soft music) and food (novel items that are not a part of an animal's 'normal' diet). We strive to diversify the enrichment items offered so that the animals are stimulated in a number of ways.

## Enrichment Type and Role

Objects are very important to our enrichment program. Some items are hung to provide sparring opportunities; some items are designed to prolong feeding time, while others are more for visual stimulation. Objects with different textures are offered in a variety of shapes, sizes, and colors. Because we offer such diverse items, some animals more readily accept certain objects that we use during training sessions, such as target poles, vet totes, carts, and crates. We successfully trained a yellow-backed duiker (*Cephalophus silvicultor*) to stand in front of a yellow radiograph machine by first training her to stand in front of a yellow kitty litter container bolted to a wooden platform. Because the duiker was already accustomed to the kitty litter container, training for the x-ray was easier and less stressful for the animal (Bouwens et al, 2008).

When offering scent enrichment, our goal is to introduce the animals to a smell that they are not accustomed to, and/or provide an opportunity for the animals to explore their environment. The scents that we provide our hoofstock are spices, extracts, perfumes/colognes and bedding or furniture from another animal's area. We also attempt to vary the ways in which the scents are offered and their location. Scents are put on walls, floors, bedding, props, and substrate. We have used scent enrichment during the initial stages of training as well. Our male waterbuck (*Kobus ellipsiprymnus*) had been very reluctant to approach a scale platform despite the keepers trying numerous training methods and various rewards. When some of the female waterbuck's bedding was placed onto the platform, the male stepped right up onto the platform with no hesitation. He stayed on the platform for a few minutes sniffing every single piece of the hay. After that day he stepped up onto the platform regularly without pause.

Our audio enrichment library consists of hanging small, soft-sounding wind chimes outside in the corral areas or playing one of over 50 CD's ranging from classical music to various nature settings. The nature CD's cover a wide variety of sounds such as ocean waves, sounds of the jungle, whale songs, frog calls, bird calls, and sounds from the African plains. These CD's are generally played in the barn when the animals have access to an outdoor area. That way the animals have the choice to go outside to avoid the sounds. Audio enrichment is always played at a low volume and animals are monitored to make certain they do not react negatively. We have noted that the giraffes (*Giraffa camelopardalis reticulata*) are very attentive when whale sounds are played, while the bongos (*Tragelaphus eurycerus*) have reacted with an alert posture to lion roars, despite hearing daily roars from the lion exhibit located across the public path.

Although audio enrichment (as well as other types of enrichment) may not give the "wow" reaction that we often look for when offering enrichment, it can arouse the animals and heighten their awareness. As we all know, in the wild animals are bombarded with sensory stimulation and they must determine what is detrimental versus what is benign. So even though auditory, and often times scent enrichment, may not elicit overwhelming responses, we believe that the animals are still being enriched.

Foods are another type of enrichment that the hoofstock animals receive. Browse is part of some animals' daily diets, and for others, browse is offered as often as possible. Other foods that are offered in small quantities are no sugar added jellies, produce, peanut butter, sugar cane, and leaf-

eater biscuits. In some cases, we can more easily medicate animals with foods that they only receive occasionally, so knowing which foods an animal prefers is very helpful. Also, some of these foods are offered during training sessions as jackpots.

Another great way that we can enrich our hoofstock is to move animals around to different stalls and corrals. This provides the animals with a variety of new scents and props to investigate, and many times the neighboring animals housed on either side are different as well.

**Record Keeping**

In order to make certain that the animals receive enrichment of all types every week, the keepers use a monthly calendar that lists a category of enrichment that should be provided for each species, each day. According to the sample calendar in Figure 1, Tuesdays in the month of February are scent days for most species, so all of these animals should receive a scent of some sort. Each month the categories are randomly reassigned to different days.

**Figure 1**

Sample Enrichment Schedule for November							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Rhino	audio	food	scent	scent	keeper choice	object	training
Giraffe	tongue manipulation	food	training	audio	keeper choice	object	scent
Zebra	training	food	Scent	scent	keeper choice	object	audio
Duikers	object	food	Scent	scent	keeper choice	training	audio
Waterbuck	object	food	Scent	scent	keeper choice	object	audio
Bongo	object	food	scent	training	keeper choice	object	audio

Because of time constraints and varying keeper schedules, categories are used instead of specifying a particular enrichment item to be offered. This approach allows the keepers the flexibility and creativity to choose items that they prefer to use.

Because we have a number of animals to enrich, we tend to have the same or similar categories for all of the animals for the day. For instance, if the black rhinos (*Diceros bicornis*) have food enrichment



Zoo Atlanta black rhino enjoying enrichment items.  
(Photo: Adam K.Thompson/ZooAtlanta)

on Thursday, most, if not all, of the other animals will also receive food enrichment that day. We have found that it is easier and less time-consuming for the keeper to gather and distribute enrichment this way. It should also be mentioned that keepers must give at least one item from the daily category, but keepers are encouraged to offer additional enrichment from the same or different categories. For instance a keeper can give an animal browse (food) and a traffic cone (object) on the same day, as long as at least one of the items given is from that day's category.

The enrichment categories that we use for the calendar are audio, training, object, keeper choice, scent, and food. On a day when the category is keeper choice, the keepers can offer any enrichment item they want from the category of their choice. The giraffes have an additional category, called tongue feeder manipulation. Our giraffes are almost exclusively fed grain from a five-gallon plastic water jug hung from a pulley



rope in their holding area. This type of feeder prolongs feeding time and increases the amount of tongue manipulation the giraffe must use to get to their food (Bouwens, 2003). At least once weekly, various objects such as KONG® toys, Wiffle® Balls, small PVC pieces, or plastic/rubber dog toys are put inside these feeders. The giraffes must maneuver their tongues around these objects to get to their grain. This extends feeding time and exposes the giraffes to different textures and feeding challenges.

To select an enrichment item for an animal, the keeper first checks the enrichment calendar to see what category is assigned to that day. Then the keeper refers to the record form to determine what enrichment from that category has not been used with that animal within the last two months. Our form is an Excel® file that has the various categories listed in columns. See an abbreviated version of our record form in Figure 2. All of the approved enrichment items in a given category are listed below the category name. When an item is used, the date it is used and initials of the keeper who provided the item are recorded under the animal's name.

**Figure 2**

Duiker Enrichment							
Date Offered		Date Offered		Date Offered		Date Offered	
Scents		Audio		Objects	Dasher	Lacey	Foods
Allspice	EF 1/18	Africa Awakens		55 gal Barrel			Alfalfa cubes
Anise		African Journey	CD 1/16	5 gallon bucket (no handles)	AB 1/17		Allfruit
Basil		Amazing Amazon		Bamboo/PVC windchimes			Applesauce
Caraway Seed		Amazon Odyssey		Blue feeder container			1/19 EF
							Berries

Some approved items can't be used at all times because they are seasonal or need to be replaced, built, repaired, or purchased. These items are listed in a separate group underneath the list of available items to prevent confusion. With these items separated from the others, keepers and curators can easily see what items need to be addressed.

This system has worked well for the hoofstock department. We are able to record items, see what has been used recently and keep up with broken items or report when items have run out. Generally one person oversees the inventory of enrichment supplies and ensures approved items are available. This person also changes the calendar every month, clears the record form, and archives the old enrichment records.

Providing our hoofstock animals with ever-changing environments helps them cope with change and allows them to adjust more easily to it. It is important to note that whenever a new item is added to our enrichment program, keepers monitor the animal's initial reactions. If the animal is overly fearful or aggressive, the item is removed immediately.

All of the enrichment items offered are done so with a purpose and a goal. Because of this we have a very successful enrichment program that has facilitated training and many other husbandry practices.

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# Managing Ungulates in Mixed-Species Exhibits at Disney's Animal Kingdom Lodge

*By Steve Metzler, Assistant Animal Operations Manager (Assistant Curator)  
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## Introduction

Disney's Animal Kingdom Lodge (DAK Lodge) is an African lodge-style resort adjacent to Disney's Animal Kingdom® theme park at Walt Disney World®. Guests of DAK Lodge have the unique opportunity to observe exotic animals in a natural setting from the private balconies of their hotel rooms, from special viewing areas, and from picture windows in the hallways throughout the resort. In all there are 46 acres of animal habitats at DAK Lodge that are broken down into four separate mixed-species savannas. The collection of animals consists primarily of African ungulates and birds. We currently manage 16 species of African ungulates in mixed-species exhibits. Our bird collection is equally important with 15 species currently managed, but for the purposes of this article I will be focusing on the ungulate collection and management.

Over the ten years DAK Lodge has been in existence, ungulate management has evolved and been refined to meet the ever demanding needs of these species, both in the unique environments at DAK Lodge and in the zoo community as a whole. DAK Lodge has many of the same objectives and challenges that other zoological facilities have. The overall health and well-being of the animals in our charge is always the top priority. Also extremely important is providing an outstanding animal viewing experience for our guests. In addition, through creative management of mixed-species habitats, DAK Lodge is trying to maximize its potential to assist with the priorities of the various AZA Ungulate Taxon Advisory Groups. DAK Lodge has adapted and managed to balance these many objectives through a variety of husbandry practices and collection planning to ensure its place in securing a future for African ungulate populations.

## The Savannas

At Disney's Animal Kingdom Lodge we have four distinct savannas. The six-acre mixed woodland and savanna habitat of Pembe Savanna is perhaps our most unique mix of species. It is home to okapi, red river hogs, ankole cattle, antelope, and birds (See Table 1). Okapi and red river hogs have not traditionally been housed in mixed-species exhibits. Those

that have, typically have been with just one or two other species. At DAK Lodge we wanted to provide unique viewing experiences for our guests by exhibiting and managing these two species differently than had been done before. We have successfully exhibited red river hogs in large mixed-species exhibits for seven years and okapi for three. This has been extremely popular with our guests and rewarding for the animal care team. By adding these species to mixed-species habitats, it has allowed us to keep and display species at DAK Lodge that we would not have been able to otherwise. In addition to red river hogs and okapi we have three established breeding groups of ungulates in this savanna: nyala, Thomson's gazelle and impala.



Hartmann's mountain zebra and giraffe in the Sunset Savanna at DAK Lodge. (Photo: Steve Metzler)



**Table 1: Pembe Savanna Animal Collection**

Okapi ( <i>Okapia johnstoni</i> ) 1.2	Impala ( <i>Aepyceros melampus</i> ) 1.5
Red river hog ( <i>Potamochoerus porcus</i> ) 1.2	Ankole cattle ( <i>Bos taurus taurus ankole</i> ) 0.1
Nyala ( <i>Tragelaphus angasii</i> ) 2.7	Abyssinian ground hornbill ( <i>Buocorvus abyssinicus</i> ) 1.1
Common waterbuck ( <i>Kobus ellipsiprymnus</i> ) 0.4	Blue crane ( <i>Anthropoides paradisea</i> ) 1.1
Thomson's gazelle ( <i>Eudorcas thomsonii</i> ) 2.5	Ruppell's griffon vulture ( <i>Gyps rueppelli</i> ) 0.4

The Sunset Savanna is our largest savanna at 18 acres. It is one of three of our habitats designed with giraffe as the key species. The giraffe may be the stars of the show in our guests' minds but our primary focus in management and conservation messages is the Hartmann's mountain zebra herd. We currently have a breeding group of 1.4 Hartmann's mountain zebra. This herd will grow to 1.6 with the acquisition of some new animals this summer. Zebras are always easily recognizable and popular animals with our guests. The 2011 Equid TAG RCP recommends that plains zebras (*Equus burchelli*) be replaced with other equid species whenever possible (Wild Equid Taxon Advisory Group 2011). For this reason and due to the general need for institutional support and captive breeding, DAK Lodge has invested in working with this species. (See Table 2 for complete listing of species).

**Table 2: Sunset Savanna Animal Collection**

Giraffe ( <i>Giraffa camelopardalis</i> ) 1.3	Blesbok ( <i>Pygargus pygargus dorcas</i> ) 1.0
Hartmann's mountain zebra ( <i>Equus zebra hartmannae</i> ) 1.4	Ankole cattle ( <i>Bos taurus taurus ankole</i> ) 1.1
Blue wildebeest ( <i>Connochaetus taurinus albojubatus</i> ) 0.3	Ostrich ( <i>Struthio camelus</i> ) 0.5
Roan antelope ( <i>Hippotragus equines</i> ) 2.1	Marabou stork ( <i>Leptoptilos crumeniferus</i> ) 3.0
Common eland ( <i>Taurotragus oryx</i> ) 1.0	East African crowned crane ( <i>Balearicq regulorum gibbericeps</i> ) 3.0

The 11-acre Arusha Savanna is also a savanna focused around giraffe, but is also home to our bachelor group of red river hogs. Here the hogs are housed with giraffe, birds, and a number of ungulate species like wildebeest, plains zebras, and a bachelor group of roan antelope. (See Table 3 for a complete list of species).

**Table 3: Arusha Savanna Animal Collection**

Giraffe ( <i>Giraffa camelopardalis</i> ) 0.4	Ankole cattle ( <i>Bos taurus taurus ankole</i> ) 1.1
Common zebra ( <i>Equus burchelli</i> ) 0.2	Pink-backed pelican ( <i>Pelecanus rufescens</i> ) 7.3
Blue wildebeest ( <i>Connochaetus taurinus albojubatus</i> ) 1.0	East African crowned crane ( <i>Balearicq regulorum gibbericeps</i> ) 1.1
Roan antelope ( <i>Hippotragus equinus</i> ) 3.0	Egyptian goose ( <i>Alpothen aegyptiacus</i> ) 1.0
Red river hog ( <i>Potamochoerus porcus</i> ) 2.0	Helmeted guinea fowl ( <i>Numida meleagris</i> ) 9.0
Thomson's gazelle ( <i>Eudorcas thomsonii</i> ) 0.7	Vulturine guinea fowl ( <i>Acryllium vulturinum</i> ) 1.0
Impala ( <i>Aepyceros melampus</i> ) 2.6	

The 11-acre Uzima Savanna is another location we have chosen to focus on breeding groups of ungulates including bontebok and common waterbuck. Next year we plan to add a breeding group of wildebeest to this savanna. (See Table 4 for a complete list of species).

**Table 4: Uzima Savanna Animal Collection**

Giraffe ( <i>Giraffa camelopardalis</i> ) 1.1	East African crowned crane ( <i>Balearicq regulorum gibbericeps</i> ) 4.1
Common eland ( <i>Taurotragus oryx</i> ) 2.0	African greater flamingo ( <i>Phoenicopterus roseus</i> ) 19.22
Sable antelope ( <i>Hippotragus niger</i> ) 1.1	Ruppell's griffon vulture ( <i>Gyps rueppelli</i> ) 2.3
Bontebok ( <i>Damaliscus pygargus pygargus</i> ) 2.5	African spoonbill ( <i>Platalea alba</i> ) 3.0
Common waterbuck ( <i>Kobus ellipsiprymnus</i> ) 2.5	Common shelduck ( <i>Tadorna tadorna</i> ) 1.0

## Species Selection

The species selection process at Disney's Animal Kingdom Lodge is similar to that of many zoological institutions today. First and foremost we ensure that the species selected will do well with the climate of Central Florida and the management style of DAK Lodge. Animals at DAK Lodge are managed on the savanna exhibits 20-22 hours per day and shifted into holding for feeding for 2-4 hours per day. This requires the majority of species to be on exhibit overnight throughout the year. The weather in Central Florida overall is quite mild and during much of the year it is similar to



many of the native habitats of our African collection. It is very warm and tropical in the summer with frequent rains, yet in winter temperatures occasionally fall to near freezing overnight. This means that the majority of animals on our savannas need to do well with this temperature range throughout the year without much in the way of supplemental heating or cooling. We have, however, chosen to exhibit a few of the more tropical species like okapi and red river hogs that need to be held in overnight in the winter months for supplemental heat. As this is a minority of the species it allows us to continue to have a large number of animals stay out on display overnight in the winter for our guests to view from their hotel rooms. With the heavy rains in summer we have found that the more arid species tend to not do very well in our habitats. Unfortunately the warm wet environment of the Central Florida summer allows endoparasites to thrive. The more arid species tend to be much more affected by this. For this reason we have phased out species that we have exhibited previously that suffered from severe parasitism, like gemsbok (*Oryx gazella*) and Grant's gazelle (*Nanger granti*).



Red river hogs and waterbuck in the Pembe Savanna at DAK Lodge. (Photo: Steve Metzler)

The overall animal visibility for our guests is always in focus when selecting ungulate species. We need to ensure that our guests will have outstanding views of our animals from their hotel rooms and from all areas around the resort. There are certain ungulate species that our guests typically request and easily recognize. We are continually balancing the guests' desire for large recognizable species with having a conservation-minded and responsible collection of ungulates that match up to the priorities of the various AZA Taxon Advisory Groups that our animals represent. We currently have species that represent the Equid; Pig, Peccary, and Hippo; and Antelope and Giraffe TAG's. Some of the key ungulate species that our guests recognize and appreciate are giraffe, zebra, wildebeest, and ankole cattle and bird species like ostrich. These are species that we are committed to keeping as they are key components of our exhibit and go a long way towards the overall satisfaction of our guests. We then also have several of the species that the guests don't easily recognize but that are noticeable and want to learn more about like eland, roan antelope, okapi and red river hogs. By maintaining good numbers of a few of our more recognizable species, we then are able to add other species that

are less of a draw for our guests but that are in need of holding space and captive breeding in zoological facilities.



Okapi and nyala herd in Pembe Savanna at DAK Lodge. (Photo: Lindsey Kirkman)

Sustainability both for the future of the DAK Lodge animal collection and to contribute towards the various TAG priorities has been of particular focus in the last five years. The fifth addition of the AZA Antelope and Giraffe Advisory Group Regional Collection Plan commented on the results of a 2008 space survey. It stated that the "projected decrease in space for antelope of nearly 1,000 spaces since the

1999 Space Survey and the decline in overall future space for antelope, giraffe, and okapi combined through the last three RCPs are greatly concerning." (AZA Antelope and Giraffe Advisory Group, 2009). At DAK Lodge we have focused on increasing the number of ungulate species and breeding groups we are holding to add more spaces for TAG-recommended animals. We currently have active breeding groups of bontebok, waterbuck, nyala, okapi, Thomson's gazelle, Hartmann's mountain zebra, and impala.



## Animal Introductions

Over the years we have done several introductions of new animals to herds, new species to exhibits, and training of animals to come into their new barns. One of the primary keys to Disney's Animal Kingdom Lodge's success in managing ungulate species together in mixed species exhibits, is the careful process that we follow when doing new introductions. Each situation is treated a little differently, but we do have a general process that has worked successfully over the years. We start by bringing new animals to the barn that they will be brought into on a daily basis and hold them in for one to two weeks so they can become familiar and comfortable with this location. We then will give the new animals a "howdy", or visual access, to all or many of the other animals that will be sharing their habitat.



Waterbuck in acclimation pen being introduced to nyala. (Photo: Steve Metzler)

During this time, aggression levels and behaviors are monitored closely and we do not proceed to the next step unless we are comfortable with what is observed. When introducing an entirely new species this process is done slowly and carefully. When introducing the red river hogs to new species for example, this process has taken up to a month or more. The hogs were a considerably different type of animal than what many of the other ungulate species had seen before. They had much more interest and apprehension with the hogs than they had shown towards other ungulate or bird species. Once the initial "howdy" process is over and full introductions begin, we introduce the new species to the other animals, one species at a time. We choose an order of species introduction based on species previous behaviors and will hold off higher risk introductions until

the new animals are established and comfortable in their surroundings. Again, we do not proceed to add other species until we are comfortable with how things are going. Keepers are present at all times, ready to intervene if introductions appear to be threatening the health of any of the animals involved.

## Training and Shifting

At Disney's Animal Kingdom Lodge the animals are trained to shift off of exhibit and into the barns when they hear the audio cue to which they have been conditioned. Each day, at a consistent time, all of the ungulate species are brought into the barns to be separated into their appropriate feeding groups and given their grain diets. Herds of animals of the same species are brought into the barns in the same locations and then separated from each other as needed from there. For example, herd males of breeding groups are typically separated from the females in holding as they tend to be more aggressive in small spaces and run the females around. This can become counterproductive when trying to make entering holding a positive experience, to get the animals to consume their grain diets, but also dangerous in the confines of the barn yards and stalls.

Having the ungulate species clear of their habitats for 2-4 hours per day also allows for better overall habitat upkeep. At DAK Lodge we have the unique situation of having the buildings of the hotel bordering much of the animal habitats. This means that not only the animal habitats themselves require upkeep, but also the buildings of the hotel. This time that the animals are in the barn each day allows for our horticulture, irrigation, pest control, and facilities teams to safely access and work in the savannas. This also gives the keeper team time to clean the fecal matter from the savanna to aid in parasite control, clean the animal pools and drinkers, and attend to any of the bird species that are not brought into holding areas on a daily basis like the flamingos and cranes.

While animals are in the barn each day the animal husbandry team does training sessions with several of the species. For many these sessions are as simple as passing them over a scale on a regular basis so that weights can be obtained. For others, like the giraffe and Hartmann's mountain zebra, this training is more extensive. The giraffe are trained in the restraint chute each day so that the husbandry team can desensitize them for medical exams and reactive deworming. The Hartmann's mountain zebra are regularly trained to stop and stand still in a foot bath so that their hooves can be soaked in a solution to deter white line disease and aid in overall hoof health. We have also been



able to train red river hogs and okapi to receive standing ultrasounds to check on the progress of pregnancy.

The Central Florida climate and our strategy of managing ungulates for 20-22 hours on landscaped, irrigated pastures, has led to some challenges for hoof care, parasite control, and proper nutrition, all of which are being actively focused on by the Animal Programs team with several ongoing projects and studies. The regular shifting off of exhibit and husbandry training that is done in the barns on a daily basis has made it possible for us to address and manage these issues.

### **Breeding, Hand-Raising, and Bachelor Groups**

At Disney's Animal Kingdom Lodge we have managed several breeding groups in our mixed-species habitats. We have had 12 species of ungulates and three species of birds successfully breed and raise young in our mixed-species exhibits including giraffe, Hartmann's mountain zebra, bontebok, waterbuck, and red river hogs among others. Managing multiple breeding groups in mixed species ungulate exhibits can be difficult but we have found it to be necessary to responsibly manage many of the species that DAK Lodge is holding. Considerations were given as to the potential for ungulate male aggression towards females and other species. Before establishing any breeding groups a good plan was made as to how to carefully introduce the males, what to do with them if they did not work out in a breeding group in a mixed-species setting, when to hold the females in for calving, and at what age calves should be put back onto the savannas. Typically we hold pregnant females in the barns to give birth a few weeks before parturition and let calves and mothers back out into the mixed-species habitats when they are between one and three months old.

At DAK Lodge it is current practice to pull and hand rear female calves of a few of the species that tend to be more flighty, like Thomson's gazelle and impala to allow for easier management as adults. Holding in the barns, shifting, training, and medical procedures are considerably easier to manage in these hand-raised adults than in mother-raised animals. It has also been necessary to hand rear several species of ungulates that had to be pulled from their mothers due to medical reasons. This has been done with red river hogs, bontebok, and nyala. When we have found it necessary to hand raise male antelope we have taken precautions to prevent them from imprinting on people as much as possible. This was done by providing bottles from outside the holding and separating the act of feeding from the association with humans. When doing so we try to house them with adults of their herd at



Bontebok breeding herd with calves and nyala bachelor group at DAK Lodge. (Photo: Steve Metzler)



Nyala bachelor group at DAK Lodge.

(Photo: Courtney Janney)

as early an age as possible so that they are able to habituate to the herd lifestyle and to others of their species.

When breeding herd species of ungulates it is likely you will end up with a roughly 50/50 sex ratio of males and females. Females can often be kept together in large herds with a breeder male successfully, but the issue of what to do with the additional surplus males that are produced also needs to be addressed. Increasingly it is becoming more and more necessary for zoological institutions in the United States to set up bachelor groups of males. DAK Lodge has managed ten different species in bachelor groups with varying success over the years. In the future



we intend to add additional bachelor groups of new species, and continue to work through the challenges of bachelor group management in hopes that we may find this to be a viable option for more species down the road.

### Conclusion

In the ten years that Disney's Animal Kingdom Lodge has been open we have learned a great deal about managing ungulates in mixed species exhibits. DAK Lodge is heavily invested in African ungulates and hopes to contribute to the long term future of ungulate management in the zoological community.

### Acknowledgements

I would like to thank the entire DAK Lodge Animal Programs team both past and present for all their hard work and creativity in making the DAK Lodge animal management program what it is today.

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## Ungulate TAGs Connecting with Keepers: An Update

By

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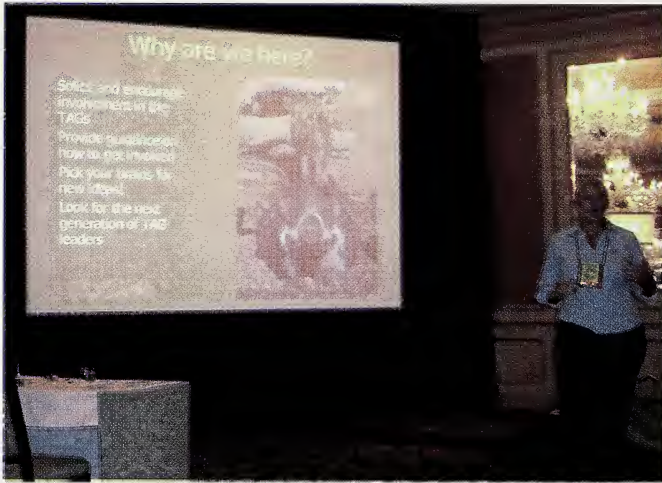
The AZA Ungulate Taxon Advisory Groups (TAG) are committed to mentoring the next generation of ungulate management leaders and using the talents of zoo keepers to further their mission. Members of the Ungulate TAGs hosted the workshop "Connecting with Keepers" at the 2010 National AAZK Conference in Philadelphia. The purpose of the workshop was to solicit and encourage involvement in the TAGs, provide guidance on how to get involved, pick the brains of those in attendance for new ideas, and look for the next generation of TAG leaders. The results of the survey from the workshop and feedback during the workshop helped the TAGs devise an action plan to involve keepers more.

On 23 August 2010 Martha Fischer, Equid TAG Chair and Antelope and Giraffe TAG Chair, Dan Beetem, Antelope and Giraffe TAG Vice-Chair, Steve Castillo, Cervid TAG Vice-Chair, Conrad Schmitt, Buffalo, Bison, and Cattle TAG Chair, Jim Haigwood, Caprid TAG Co-chair and Christy Poelker, Antelope and Giraffe TAG Program Leader for Grant's Gazelle hosted the workshop "Ungulate TAGs: Connecting with Keepers". The break before the workshop was generously sponsored by the Antelope and Giraffe TAG so that everyone had fuel for participating in the workshop. There was an icebreaker game so that everyone would feel more comfortable with each other and practice their networking skills (while also learning about some great ungulate species). Each presenter then shared their experience in the zoo world and how they first became involved in the Ungulate TAGs.

The next part of the presentation highlighted the opportunities to become part of TAGs from the perspective of present TAG members. The suggestions included attending mid-year meetings, signing up for listservs, keeping an eye out for new opportunities, asking your manager for introductions, and reaching out to a TAG Chair or Program Leader. Some ways to get more involved are to be your zoo's Institutional Representative, apply to become a Studbook Keeper or SSP® Coordinator, offer your talents to help with the website, fundraising and any other ideas you can come up with. The TAGs have also identified that there is a need to get hands-on training with this unique group of animals by offering ungulate care workshops, which you can read more about at [www.antelopetag.com](http://www.antelopetag.com).

The TAG representatives at the workshop were extremely interested in hearing what keepers would like from the TAGs and solicited suggestions on how to improve the connection with keepers. The first area of improvement that participants at the workshop suggested was communication with keepers. This goal could be met by advertising program vacancies, workshops and meetings in the *Animal Keepers' Forum* and the Member's Only section of [www.aazk.org](http://www.aazk.org). Another way that many keepers get information is Facebook®, which the TAGs could use to reach out to people. Many keepers also said they did not know they were allowed to participate in TAGs and would urge TAG leadership to communicate this to keepers and their managers.

The cost prohibitive aspect of keepers becoming involved in TAGs was also discussed. Many keepers said they would be interested in attending workshops or classes about studbooks and other AZA programs or TAG meetings in conjunction with AAZK conferences since this is often the only meeting they can attend throughout the year. It was also mentioned that keepers should apply for AAZK or AZA travel grants and learn the budgeting process at their zoo to increase their chances of receiving funding.



Workshop presentation on "Connecting with Keepers" at the 2010 AAZK Conference in Philadelphia.

Several workshop participants also voiced concerns that their managers, curators or zoos were not supportive of keeper involvement in TAGs. The leadership of the Ungulate TAGs will work to spread the word that they are not only willing to have keepers involved but strongly encourage their participation.

Although the workshop focused on Ungulate TAGs, many keepers who work with other taxa attended and said it demystified the role of TAGs within AZA. They asked the TAG leadership to pass the

word on to other TAGs about reaching out to keepers. It seemed as though the Ungulate TAGs were leading the way on working to connect with zoo keepers.

All of the feedback that was received during the discussion period of the workshop and from the survey resulted in some concrete ways the TAGs should proceed to better connect with keepers. Hopefully, many AKF readers will have noticed that the Ungulate TAGs have posted program vacancies and midyear meeting announcements lately. They even worked to put together this ungulate dedicated issue of AKF! There has also been a concerted effort to get the word out about the ungulate care workshops, so that anyone who is interested may have a chance to improve their ungulate handling skills. Many keepers took the opportunity after the workshop to sign up for ungulate listservs. All of these people can now stay informed and communicate with others about ungulate related issues. Martha Fischer wrote letters to directors and curators thanking and encouraging keeper participation in Ungulate TAGs. She also sent letters to TAG chairs of other taxa to encourage them to engage with AAZK. Hopefully these words from a well respected leader within AZA will result in more opportunities for keepers at all zoos and with all taxa to participate in TAGs. The Ungulate TAGs have made it part of their agenda to continue to connect with keepers. If you would like to be involved in the Ungulate TAGs or have ideas for ways for the Ungulate TAGs to connect with keepers that were not mentioned here, please feel free to contact Martha Fischer at [fischer@stlzoo.org](mailto:fischer@stlzoo.org).



## *“A Voice for Captive Prey Species”*

*By Allyson O'Neill, Mammal Keeper – Hoofstock/Cheetahs  
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*The roof vent clanks. The door creaks. The wind whistles. The dust blows. The chain link rattles. The drop pins falls. The footsteps stomp. The ears perk. The heart pounds. The muscles clench. The eyes peer. The shadow appears. The deer bolts.*

This is the daily existence of a captive, stall dwelling prey species. It could be any species of deer, gazelle, or even a strong, powerful equid. In the wild, they are designed to vigilantly gauge the environment for danger. Their ears and eyes are always keen to movement and unfamiliar sounds. They graze and drink cautiously within the herd knowing there is safety in numbers but that no individual is safe.

What would it be like to live life in this constant state of fear? Aware that at any moment a mad dash across the savannah may be your only hope against a rapidly approaching cheetah. Think of it this way:

*You have settled into bed for the night. Your spouse is in the shower. Your youngest is tucked in and your teen has just headed out to meet up with friends. Outside the air conditioning unit kicks on. There are rain drops tinkering off the window panes, remnants from the passing storm. As soon as you are about to doze off you hear a noise, slight but noticeable. You sit up in bed. The room is dark but your eyes quickly adjust. Your ears pick up on a familiar but unexpected sound—the clink of the front door deadbolt. Your heart races. Who is at the door at this hour? Do you reach for the phone? Do you alert your spouse? You ease your feet to the bedside right before you hear from the base of the steps: “Hey, mom and dad, I forgot my purse. Be back by midnight.” You breathe again, lie back down, and laugh at yourself.*

Everyone knows this feeling - That pit in your stomach and tightening in your chest before panic sets in, your own instincts shouting at you to take action. What kept you from raising the alarm? A familiar voice—your own teen daughter. What could keep a deer from bolting into a fence? A familiar voice—your, their keeper.

Over time even the flightiest of animals will begin to associate their keeper with food. The simple act of dumping pelleted feed into a bowl builds trust. The animal may not come in closer, but it knows, in that moment, that it is not in any danger. With this in mind, any person should be able to provide a captive, wild animal its basic needs without causing it to panic and ultimately avoid the dashing, jumping, and crashing into walls. What about the other times, the other portions of the day, when you aren't feeding that section of the barn?

We know that when food is present a typical prey species is alert, but mostly calm. Comparatively, in the wild, the cheetah has made its kill and the rest of the herd can graze in relative safety. Dumping pellets into a bowl does not require any vocal action from the human, but what if a keeper simultaneously said, “Good morning, buddy?” The deer peeking from around the corner not only hears pellets in the bowl but it hears your presence, your voice and its tone. This association is priceless.

Now, not only does the frightened deer associate a human with food but it can recognize its keeper by the voice offering the food. A few days pass and the feeding routine remains the same. You enter the barn and prepare the feed cart. In the meantime, the deer that were peacefully resting in their bedding hay are standing and prepared to run outside as soon as that stall door moves. As the cart rolls down the aisle and you reach for the door latch you add to the normal sounds by saying: “Opening door.” The deer pauses for a moment before running out. That deer may just be thinking:

"Hey, that sounded like the person that gives me food." He still runs outside, just in case, but he gave it a second thought.

A few more days pass, maybe even a week. One day the deer you've started communicating with by verbalizing "opening door" and "good morning, buddy" doesn't run outside. He stands in his bedding hay, eyes bugged out, but not running for the hills. You open his stall door, dump his pellets, and continue feeding the other animals in the barn with the satisfaction of knowing that today you did not set off that particular animal's panic alarm. Subsequently, the rest of the individuals anxiously listening and awaiting their turn don't hear their stall neighbor scrambling for safety.

It gets even better. You may expect that it will always be in a deer's nature to jump up whenever you enter the barn. Not true. Think of it this way:

*The roof vent clanks. The wood creaks. The wind whistles. The dust blows. The chain link rattles. The drop pins falls. Before the footsteps stomp the deer hear: "Good morning, guys." The shadow appears and it's the keeper associated with the voice who gives them food. The deer remains lying restfully.*

The deer had no need to jump up. Their eyes peered and their ears perked but they heard and saw you, their keeper, the one, if only, human being they've learned to trust. Your presence and tone of voice taught them that there was no need to panic, that you will do them no harm. The day you have walked the entire length of the barn without making a single deer clench a muscle is the day you've successfully done your job.

So we've established that you cannot only calm an animal during feeding times but anytime you are present in their barn. What about the other people who pass by their stall fronts, the occasional tour group or maintenance worker? As long as you alert the animal of this "new" threat it will reduce their level of fear. A large group may be overwhelming but they will pick up on your familiar voice within the chatty crowd. Eventually the trust you've built may even transfer over to the burly maintenance worker if he too reminds himself to greet the animals before entering the barn so they know he's approaching.

Amazingly, even if, or shall we say when, a deer is frightened a familiar person can settle him or her down. Deer in total panic will do anything possible to get as far away from the source of the fear. This requires no thought on their part, only—run! The open grasslands they graze are vast and unconfined unlike the tight corners of cinder block stalls and chain link enclosures. In flight mode, it's no wonder they end up smashing head-on into fences, leaping dangerous heights, and pacing endlessly. A simple, spoken "calm down" in a recognizable, reassuring tone can pull them out of that mental state for just a split second and make them reevaluate the environment and ultimately realize there is no real danger.

Once you've established a baseline of trust with a flighty, prey species the possibilities are endless. The newly calmed and more trusting animals that have learned your voice and tone can be trained to follow you onto a scale, shift into and out of a pasture, target to a Frisbee®, or even run through a Tamer®.

Have we broken the language barrier between humans and captive prey species? The answer is no, but animals do learn to understand tone and can associate familiar words with the action that follows. They can recognize voices and distinguish various sounds. Talk to your deer, your gazelles, and your equids. Tell them that you aren't a cheetah coming out of the tall grasses. Comfort them with your voice. Give the animals you care for a better quality of life by eliminating needless injuries and minimizing stress. No captive, wild animal should have to live everyday in fear.



Tufted deer fawn and the author  
(Photo Lisa Ware/Smithsonian National Zoo)



# Managing Moose in Captivity

By Roxanna Breitigan, Animal Care Manager  
Cheyenne Mountain Zoo, Colorado Springs, CO

In May 2008 Cheyenne Mountain Zoo (CMZ) opened a new exhibit, Rocky Mountain Wild. This exhibit features animals that have historically been found in the Rocky Mountains. Prior to the building of this exhibit, moose had never been exhibited at CMZ and were only found in about eight institutions in North America. We felt we had the climate and terrain that would be ideal for this species. Tahoma the moose (*Alces alces*) came to Colorado Springs at the young age of ten months old. He settled into his new home quickly and the animal staff began working with him.

According to CMZ protocol, due to their size, moose are to be worked in a protected-contact setting which in this case was through a mesh fence. In beginning to work with and train Tahoma, we first had to find a treat that was moose-worthy. After some research and trials, we found he really enjoyed rye crackers. Once our reinforcer was found, the training could move ahead. Over the years Tahoma has been with us, the crackers have been used on a more limited basis and browse is used as a primary reinforcer.

We began by gaining his trust. Every time he came over to the fence or his dart port, we gave him crackers. This moved along fairly quickly. It was decided that the first behavior to train would be the target so we could easily move him around the exhibit and into his barn. A long extension pole was used as his target. At first, he thought it was a treat to eat or drool over. The criteria was



Tahoma the moose at Cheyenne Mountain Zoo

restricted to him having to touch his nose to the blue tip of the pole. He was reinforced for a perfect touch. The bridge was simply the word "GOOD." He quickly caught on to the concept. Once he had the target concept, we could move him around the exhibit and eventually could also target him into his pool.



Target training was the first step with Tahoma.

was placed under the fence. This was left in the exhibit for a few days so he could smell it, touch it and become comfortable with it. This did not seem to bother him, so the scale was added. We used a mobile large animal scale that fits under the board. He targeted over and stepped onto the board. Once stationed onto the middle of the board, his first weight was accurately taken. He now can be routinely weighed by any of his keepers. At the age of four years he weighs in at 995 lbs. [~451kg].

Tahoma on platform during scale training. ➤





With the scale behavior established, our focus shifted to injection training for his vaccinations. The vet staff was confident with animal staff giving Tahoma's vaccinations. We began by training a "line" behavior with the criteria of aligning both his hip and shoulder along the fence. He did this fairly quickly and with ease. We have added "shoulder" to have him come closer into the fence. This is a two-trainer behavior; while one trainer targets and rewards the moose, the second trainer uses the syringe on his shoulder. Over a short period of time, the vaccines were able to be given successfully. This technique can also be used for his TB test. We have also been able to manipulate his antlers, check his eyes, mouth and ears. He has become very calm and trustworthy with his staff.



Successful injection

Rut can be a very excruciating time for moose (and their keepers). During this time Tahoma wanted to tear up all the trees and barn. Modifications were made to his exhibit to help ease the abuse to the exhibit. A cable system was put up to hang large, sturdy toys for moose abuse and sparring. Tree protectors were added to protect the live trees from being destroyed. And finally, tree browse feeders were installed. All of these additions gave Tahoma much-needed enrichment and has helped the exhibit survive rut season.



Hanging barrel enrichment

As we worked with this species we found we had a lot more questions than answers. My curiosity grew about how others were managing their moose. Over the years that moose have been exhibited, zoos have learned more about keeping them successfully. A lot of the management of moose had been trial and error. A lot of this information had not been compiled to be used as a resource for the holding institutions. For example, we had thought that moose could live up to

20 years in captivity, but after talking to others it became clear they actually died at a much earlier age. I wanted to get some answers to the questions and conflicting information.

In order to get a clearer understanding of how moose are being managed in captivity, a simple survey was sent out to all North American zoos holding moose in 2010. The following zoos participated in the survey: Cheyenne Mountain Zoo, Columbus Zoo, Dakota Zoo, Milwaukee Zoo, Minnesota Zoo, Northeastern Wisconsin, Northwest Trek, Toronto Zoo, Riverside Zoo and Zoo Boise. The data compiled gave us a better look at how moose are managed overall in captivity and will be added to the Cervid TAG Regional Collection Plan to be used as a resource.

The survey included 12 questions regarding diet, deaths and management practices. The goal of the survey was to gather information and share best practices from other North American institutions. Since there are so few institutions holding moose, it seemed like any information gathered could be helpful for the staff who care for them. The survey data contained information from about 30 animals ranging in ages from five months to 11 years old. Moose in captivity were obtained either as orphans or were captive-bred. Orphans came from a variety of places including Ontario, Idaho, Vermont and several from Alaska. The exhibit sizes were extremely varied among the institutions. The smallest was a quarter acre and the largest was 435 acres.

Most institutions had holding barns available for their animals. The minimum holding stall was 12ft. x 12ft. [~3.66m x 3.66m] with the rest having a huge variance. The majority of respondents had some ability to separate their moose into another area to allow keeper access or to separate animals.



Most of the institutions do not have moose/mixed-species exhibits. There were a few exceptions in which moose shared an exhibit with turkeys and deer. In a very large acreage moose can share an area with bighorn sheep (*Ovis canadensis*), bison (*Bison bison*), deer (*Odocoileus virginianus*), elk (*Cervus canadensis*), mountain goat (*Oreamnos americanus*) and caribou (*Rangifer tarandus*). Sandhill cranes (*Grus canadensis*) have been tried unsuccessfully at two facilities.

Diet is always an important component to look at for any species. Since moose are such browsers in the wild they have been a challenge to figure out what diet practices seem to work for them. All of the institutions feed a specially prepared moose chow daily. Five of the ten institutions offer no hay but the other five have offered alfalfa on a limited basis. A browse list was formed from the respondents which has proven to be very helpful for the Animal and Horticulture staffs at Cheyenne Mountain Zoo.

The following is a list of approved browse used at the holding institutions:

Alder	Crabapple	Mulberry
Apple	Dogwood	Pond lilies
Ash	Douglas fir	Poplar
Aspen	Elkslip	Sugar maple
Beech	Grapevine	Sword fern
Birch	Hazel	Vine maple
Boxelder	Himalyan blackberry	Water hyacinths
Boxwood	Ironwood	Wetland species
Bradford pear	Linden	Wheatgrass
Cedar	Madrona bark	Willow
Cottonwood	Maple	Witchhazel

Along with this substantial browse list, an enrichment list was also formed. This enrichment list has not only been helpful in providing new enrichment ideas, but given keepers new ideas for training reinforcers for the moose at Cheyenne Mountain.

The following is a list of successfully used enrichment items:

Animal hair	Food dispensing toys	Peanut butter
Antler shedding conifers	Fruit-filled ice blocks	Perfumes
Apple tree silage	Grapevine balls	Plastic barrels
Balls	Green beans	Puzzle feeders
Branches	Hanging barrel	Romaine
Broccoli	Herbs	Rye crackers
Browse	Horselick blocks	Scents
Cardboard box	Ice blocks	Spices
Carrots	Leafeater biscuits	Sprouts
Cauliflower	Leaves	Squash
Celery	Logs	Tires
Endive	Misters	Watermelon
Feeder bags	Mushrooms	Whole pumpkin
		Wind socks

Rut seems to be the most challenging time for this species, both for the moose and the animal care staff. Bulls seem to go off feed for a few days to several weeks. Bulls are sometimes pulled completely off-exhibit and left alone. They are given more trees and brush to help get their velvet off. One facility removes the antlers if aggression is shown. If the moose is managed in free contact, it is put into protected contact until the antlers drop. Overall, care should be taken while working around bulls in rut.

The age of moose dying was actually found to be much younger in captivity than in the wild, which

is the opposite of most other zoo animals. There was quite a range in the ages of moose deaths. The youngest noted in this survey was one year old and the oldest was 16 years old. The average age at time of death was found to be nine of age with a variety of causes. These causes included the following: anesthesia complications, wasting away, restraint or move complications, dehydrations, digestive infection, digestive malabsorption syndrome, hip issues, exhibit mate trauma, exhibit trauma, heart failure, infectious and non-infectious diseases, ingestion of wire (punctured intestinal wall), pneumonia, respiratory infection, throat/mouth cancer and euthanized due to old age issues.

Managing moose in captivity can be challenging but as we learn more and share that knowledge it can become a little easier, as well as more rewarding both for staff and the animals. At Cheyenne Mountain Zoo we have found that by building a strong trainer/animal relationship, using operant conditioning and getting creative with enrichment, a young moose can be healthy and engaged in his exhibit. Tahoma is still a young moose but we are confident that, with continued dedication from Animal Staff, he will thrive throughout his life at Cheyenne Mountain Zoo.



Enrichment like this hanging ball and browse feeders helped limit tree damage during Tahoma's rut.

*(All photos accompanying this article are by the author)*

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## Easy Bison Enrichment in a Cash Strapped Economy

*By Phil Coleman, Lead Keeper  
Elmwood Park Zoo, Norristown, PA*

It can be difficult and expensive to enrich large ungulates. Commercially sold enrichment for large animals can be very costly. The great news is, you don't have to buy an expensive toy or come up with anything too complicated to make great enrichment for these animals.

Many captive ungulates enjoy sparing with exhibit mates, exhibit furnishings, fencing, food bowls, and even the barn wall. This is a natural behavior for hoofstock animals. It strengthens muscles and shows other exhibit animals and prospective mates how great their genes are for future progeny. It also gives the animals an outlet for extra energy, as well.

So, what unique toy can you give large ungulates for enrichment that they can play with and not destroy? You must consider the possible danger the enrichment might pose to the animal, their exhibit-mates, or your guests. Some previous attempts at bison (*Bison bison*) enrichment at Elmwood Park Zoo had ended up damaging the fence. The decision was made that the next enrichment item must be either extremely heavy or affixed to something very sturdy in the exhibit.

The idea was proposed to see if a local soda company could donate discarded 55-gallon plastic barrels for enrichment purposes. Great idea! They are free and you might even be able to get the company to drop them off at your institution. Win, Win! The Elmwood Park Zoo was fortunate enough to have



two of these barrels donated to us free of charge. They were easily cleaned out by keeper staff and drain holes were drilled in the bottom so the barrels would not collect water.

The next problem was how to attach these barrels to the enclosure, in such a way, that the bison don't destroy the exhibit, hurt themselves or toss the barrels out into the public? We decided to hang a barrel from the 2in. x 6in. [5.08cm x 15.24cm] rafters in our nighttime holding area. The holding yard seemed the best choice because the rafters are very sturdy and this area has two sets of fences (an inner fence and an outer fence). These two fences gave us an extra layer of security. If the barrel comes down and the bison play with it, this extra fencing would prevent them from throwing it out of the holding and into the public area.



Barrel is hung from barn rafter using leftover tow chain

The barrel was hung from the rafters by a 6ft. [~1.83m] piece of leftover tow chain and the open end of the chain was closed off by a clevis fastener. These two items we already had at the Zoo, so again we did not have to purchase any extras for this enrichment toy.

The bison were very interested in what was going on in the holding yard when we were putting the barrel up that afternoon. Once we let the bison into the holding area, after zoo hours, they were initially afraid of their new toy. After a few minutes, the females came over to investigate the new toy and proceeded to lick it, possibly thinking it was a food item. Our male decided to eat grain and ignore it at first. After five minutes or so, the male came over and knocked it with his head and walked back over to eat more grain. We watched for

about 15 minutes in total without much action. Later in the day, a keeper who worked the area called over the radio to announce that the male bison was really "enjoying" the barrel. Unfortunately, no one had a camera for the main action!

In these times where every dollar counts, it pays to think of ways to use what you already have lying around and utilizing community partners to get items donated for enrichment. Take a second look around your storage closet and have a chat with the maintenance department, you might have enrichment treasures hidden in that old hose or dusty bucket!



Bison check out 55-gallon enrichment barrel

*(Photos by the author)*

# The Way Home: Moving a Herd of 1.6 Reticulated Giraffe into a New Facility

By Aimee S. Fannon, Head Giraffe Keeper,  
Fort Wayne Children's Zoo, Fort Wayne, IN

## Introduction

In October 2010, after much training and hard work, Fort Wayne Children's Zoo's herd of 1.6 reticulated giraffe (*Giraffe camelopardalis*) entered a new facility of their own free will. This long awaited move for the zoo's seven giraffe took careful planning and execution by the giraffe staff. The old barn had been inadequate for some time: spaces were crowded, shifting was a challenge, and training opportunities were extremely limited. In the winter of 2010, we received a very generous donation that enabled us to build a new giraffe facility. We were overjoyed, but realized that we had a lot of hard work ahead of us. The new barn, by Fauna Research, was to be built on the opposite side of the giraffe's outdoor exhibit space. There would be a chute area/exercise yard that leads from the exhibit to the new barn. The new facility would be four times larger than the old barn, and would be complete with a Fauna Research Giraffe Tamer®. It would improve the care of our herd (and the sanity of our keepers!) in a multitude of ways. There was one thing we knew for sure: we wanted the herd to walk into the new barn of their own free will. Each giraffe has his or her own personality, and getting them to enter the barn would require considering each giraffe's individual challenges and needs. The herd consists of Jelani, the somewhat fearless bull; the natural herd leader and oldest giraffe Zuri; her calf, Zahra; and four-year-old Mystic. Also in the herd is Kali, another older female; Luna, Mystic's half-sister; and Luna's calf, Kesi. As anyone who works with giraffe knows, asking them to follow a keeper into a giant, shiny, new barn was like asking them to follow a keeper off of a cliff. It would take a lot of patience and understanding, but we gave the herd the best tools we could. Utilizing these tools and the strong bond of trust between giraffe and keepers, the move was safe and successful.

## Challenges

We faced many overwhelming challenges in the move. The barn was not completed until October, which left us racing against time and the impending Indiana winter to get the giraffe moved into the new building. The entrance to the new barn was on the opposite side of the exhibit. The herd spent most of their time at the hayracks and public feeding platform, both of which are at the front of the exhibit. They only occasionally ventured to the back of the exhibit. Due to the ongoing construction, there were loud noises, large equipment, and strange people surrounding the area every day. We have protected contact with our giraffe, so we could not always go where we were asking them to go. Every night the giraffe returned to their old barn, and the whole process was started anew the next day. Then there was the largest challenge of all: Kali and Luna. When Kali arrived at our zoo at age 15, she was overwhelmed with the changes around her. While she was fine in the barn and exercise yard, she refused to enter the exhibit, despite strong encouragement. She remained at the barn while watching the others go to and from exhibit every day for five years. But she wasn't alone. When Luna and Mystic arrived in 2007, Luna quickly bonded with Kali. Both have extremely cautious personalities, even for giraffe. Keepers were unable to get Luna to follow the others to the exhibit. She stayed at the barn for three years. We wanted them all to cross the exhibit and enter the new barn willingly, but how could we do that when two members of herd had never even been into the exhibit?



Jelani and his oldest daughter, Zahra,  
explore the new chute.



Many ideas were implemented to help get Luna and Kali to go to the exhibit. While there would be periods of great improvement, there was never complete success. In early June 2010, we decided to request the aid of Steve Martin and Wouter Stellaard of Natural Encounters, Inc. They had experience with the situation, and shared with us the desire to get Luna and Kali to join the others. Not only did we want to improve their quality of life, but we wanted the process to be as positive as possible. With the expertise of Steve and Wouter, we were able to use a mild aversive in the most positive way possible. We created a "moveable wall" by securing tarps to long pieces of narrow, plastic pipe. Several people were required for the process, but we tried to place the giraffe keepers at the entrance to the exhibit. We wanted to be something positive (like the rest of the herd awaiting them in the exhibit) for them to move toward. We created two "walls", each carried by two people (one on each end). We worked with Kali and Luna separately. We closed off the area completely to the public. Once the individual giraffe was in the exercise and had access to the exhibit, keepers would enter the space at the back of the yard. The walls were rolled up and kept horizontal. We observed the giraffe's reaction. If the giraffe moved a step toward the exhibit, we did not move at all. If the giraffe moved toward the back of the yard, we all took a step forward.

This process was broken down into multiple levels. Each level increased the use of walls in small increments. For example, if the giraffe took another step toward us, we moved the walls into an upright position while keeping them rolled up. If the giraffe moved toward the exhibit, the keepers stopped. If the giraffe came toward the back of the yard, the keepers began to slowly unfurl the walls. Every time the giraffe took a step toward the walls, the keepers took a step toward the giraffe. This was so the giraffe had freedom in the situation. We were giving them the chance to join the others on their own. We did not force them out or frighten them. If Kali or Luna became distressed, we stopped immediately and retreated from the yard. Kali responded to this quickly, and walked into the exhibit within approximately 20 to 30 minutes. Luna took a bit longer, but did enter the exhibit



Kalahari or "Kali" exits the new barn.

that same day. Both were fairly calm, seemed comforted to be reunited with the herd, and began exploring the exhibit. Through much training, patience, and trust, we were finally able to get both Luna and Kali on exhibit. It was a more emotional experience for the staff than it was for Luna and Kali themselves. This process did have to be used on increasingly smaller scales as Kali and Luna eventually began to follow the herd to the exhibit without encouragement from keepers.

While this was a very detailed and planned process, and this brief description may not give it full justice, our main goal was to keep the experience as positive for Kali and Luna as possible. However, on Luna's second day on exhibit, she went into labor. On 3 June 2010, she delivered her first calf, Kesi. She would need to spend a considerable amount of time in the barn with her calf. Luna proved to be an extremely cautious and fiercely protective mother. Now the concern rose that when it was time to join the others, Luna's training would have been lost, as much time had passed. If Luna did not go to the exhibit again, that

meant Kesi would not go either. Fortunately, that was not the case. Luna and Kesi did join the others on exhibit. There were easy days and rough days, but Luna, Kali, and Kesi soon settled into the routine. Kali discovered the feeding platform and some adoring fans. She seemed to have a newfound confidence in herself. Now that the entire herd was in the exhibit, we were ready for the next stage of training.

## One Step at a Time

We began the next phase of training several months in advance. We wanted the site for the future entrance to the new barn to be a very positive place. Initially, we started out by offering browse and romaine lettuce at the back of the exhibit, directly in front of the new entrance site. This seemed to be too large of a step, as we found that only a few members of the herd would actually walk across the entire exhibit until they knew they would get rewarded. So we decided to break the steps down. We began by offering browse at the side of the exhibit. This area was already established as a positive place for them. We often offered reinforcement in this area, and this was also an area where I performed on-exhibit training sessions. Once all of the giraffe were taking browse from this area, we slowly began moving closer to the new entrance site, advancing a small distance each day. At first, we did this every morning. I chose to do it in the morning since the public feeding platform did not open until 0900hrs and we had the herd's full attention with no competing food interests. We kept records of which giraffe took reinforcement, how long it took for them to approach, and how long the feeding lasted. Once the herd recognized the routine, they would start moving toward us as soon as they saw us approaching the backside of the exhibit. Moving all the way to the new entrance site was a slow process. However, taking our time and being persistent paid off. The giraffe were able to see and hear the ongoing construction while taking reinforcement from keepers. They seemed confident in following us closer and closer to the new area, despite all of the construction activity.



Kesi observes from the doorway as  
Kali returns to the barn.

Once they were taking reinforcement near the new entrance site, the frequency of the feedings was increased. The public feeding platform employees would radio a giraffe keeper any time that a few members of the herd were spending time at the back of the exhibit. We would immediately go to the new entrance site and reward them. Although not every giraffe took reinforcement at these times, they were all in the near vicinity. They could observe the situation while being in the comfort of the herd. During this process, the new entrance and chute area to the new barn was completed, and we were poised to take on a new challenge.

## The Next Phase

At this point the interior of the new barn was not completed. We were able to offer the giraffe access to the chute area while keeping the barn door closed. During this time, they could hear the construction going on inside. We covered as much of the new chute fence as we could with browse. We also filled some of their favorite puzzle feeders and hung them on the chute fence. Not only were these feeders filled with preferred treats, but they were visually familiar items in a foreign space. After some hesitation, several giraffe (lead by Zuri, of course), began entering the new chute. Keepers were also present with reinforcement to help them feel more secure and to observe their reactions. We did this for several days, until the majority of the herd seemed comfortable spending some time there. This excludes Luna and Kesi, both of whom stood near the new entrance area and observed, but did not follow the others.

We then opened the large outside door to the barn while keeping the inner "screen" door closed. The giraffe could put their heads in to investigate, but did not yet have full access to the barn. Again, I felt the visually familiar items would play an important role, so we hung more puzzle feeders inside the barn for them to see from a distance. We took brush heads (our bull's favorite enrichment) from the old barn and secured them in the new barn. We also placed bedding in the stalls. The herd



appeared to be comfortable spending time in the entire chute with visual access to the new interior. All construction was completed, supplies had been moved in, and we were ready for the big move.

## Giant Leaps of Faith

When the day finally came to give them access to their new barn, we all felt ready. The new facility was filled with familiar items and dripping with delicious browse. We mixed some slightly soiled substrate (from the previous night in the old barn) in with the fresh bedding, hoping to create both visual and olfactory recognition. Because of the great dangers of startling a giraffe (particularly in a new space), only keepers were allowed in the new area. We also knocked every time we entered the new barn, so that if they were by chance inside exploring, they would not be caught off guard. Once given access, the giraffe only seemed mildly intrigued. They would glance inside the new barn, but stayed in the chute area.

Since our bull, Jelani, always demonstrated a brave nature, we decided to work with him first. He readily entered the chute area, and spent some times enjoying treats. But he took one look inside that new barn and wanted nothing to do with it! So, we attempted to let the cows lead the way. We chose to work with just four of the six girls: Zuri, Zahra, Kali, and Mystic. Luna and Kesi had not yet set foot in the chute area at all, and we hoped that seeing the rest of the herd entering the new barn would be a strong motivator for them. This had to be accomplished with some urgency as temperatures were dropping, and our time was greatly limited. Once the girls spent some time in the chute area as usual, I closed and locked the gate to the exhibit. Our plan was that the previous night would have been the very last night they spent at the old barn. I spent a lot of time alone with them, offering reinforcement at the barn door, encouraging them, and never asking them to do anything that



The author and Kali at the entrance to the new chute.

made them nervous. There were no other keepers or distractions present. Occasionally, one giraffe would approach and barely poke a nose in. This small progress was greatly encouraging to me. So, I just stayed where I was and kept things simple. In a short time, they went from small movements of progress to giant leaps of faith. Zuri was officially the first giraffe to enter the new facility. She stared inside for a few minutes, and then simply walked inside. She looked around, decided it was safe, and headed toward the hay racks. About ten minutes later, Mystic

followed her. She went in and out of the barn several times before settling down alongside Zuri for a snack. Kali was the third giraffe to enter the new barn. Kali, the giraffe that would not leave the old barn for five years, entered a strange, new place and began exploring right away. Seeing the others inside, Zahra simply ran in, seemingly without hesitation. I had four giraffe enter the new barn in less than 90 minutes. I was ecstatic. I observed them carefully all day and let them explore. At the end of the day, I closed the barn door. We left some lights on at night for a couple of weeks until we felt they were familiar with the surroundings.

The next day, we took on our biggest challenge: Luna and Kesi. The first day was fairly uneventful, with neither Luna nor Kesi even entering the chute area. The next morning I spent some time alone with them near the chute. The outside door to the barn was open so they could see the other females. To my pleasant surprise, both Luna and Kesi entered the chute and enjoyed some puzzle feeders. I locked the gate and let them spend some time getting comfortable. Next we tried letting a couple of the other girls have access to the chute area to encourage Luna and Kesi. We hoped they would follow

the others inside. Unfortunately, they would not cross the doorway into the barn. Throughout the day several keepers worked tirelessly to convince Luna and Kesi to join the others. After many hours, Kesi finally entered the barn and joined the herd. Luna was now alone, a situation which is usually terrifying for a female giraffe. It was the end of a chilly October day, and concern was growing. The other keepers left to attend to other duties, leaving Luna and I alone. I didn't know if the power of my positive relationship with Luna would be stronger than her fear. Luna had not left the old barn for three years, and I was now asking her to take an enormous risk. The rest of the females were relaxing comfortably in a nearby stall. After everything had settled down, Luna and I spent some quiet time together. After about ten minutes, Luna took the leap of faith, and joined us in their new home.

Once Jelani saw all of his girls in the new barn, all hesitation was gone. He entered the barn without a second thought. The entire herd was now safe and comfortable. After several months of preparation, within a four-day period, we had moved all seven giraffe. To say that this was an enormous relief for us would be a serious understatement.

### **Moving Forward**

We were very careful to make sure that each giraffe became comfortable in the new surroundings. We opened and closed doors slowly. We worked the doors to the Tamer® as the giraffe looked on. We kept all distractions to a minimum, and developed an indoor shifting/cleaning routine for them. We did not give them access to the aisle way or Tamer® overnight. There were loud heaters, power pumps and hoses, and new sights and smells for them to adapt to and they settled in beautifully. We were greatly looking forward to all of the training opportunities that the new facility created for us. Once they entered the new barn, the giraffe seemed to be on a roll. After one week, several of them were entering the Tamer® and taking reinforcement. After two weeks, we were able to get a few weights: something that had never been done with our adult giraffe. While all are at different levels in their training, they have all made enormous progress. Sometimes, we even have to convince Kali to get OUT of the Tamer®!



The herd explores the new entrance with ongoing construction nearby.

In February of 2011 we performed our first completely voluntary, unrestrained blood draw on a healthy adult giraffe (that award goes to Kali). The next month, we did our second draw on Jelani. Zuri is currently doing extremely well in her blood draw training. I've been able to work with them on hip injections, hoof care, body tactile, and more. They seem to enjoy the new training, and are free to leave the Tamer® if they choose to do so. All of this is done through positive reinforcement training, and has catapulted our capabilities to provide the absolute best care possible for our giraffe. It has been a growth process that both keepers and giraffe have experienced together. We gave the giraffe the best tools we could to do everything on their own, and they exceeded our expectations. We look forward to the advances that the future will bring, and I feel that my positive relationship with the giraffe is stronger than ever. While much planning and strategy went into this move, absolutely none of it would have been possible without the strong relationships formed between the giraffe and their keepers.

*All photos are courtesy of Fort Wayne Children's Zoo*



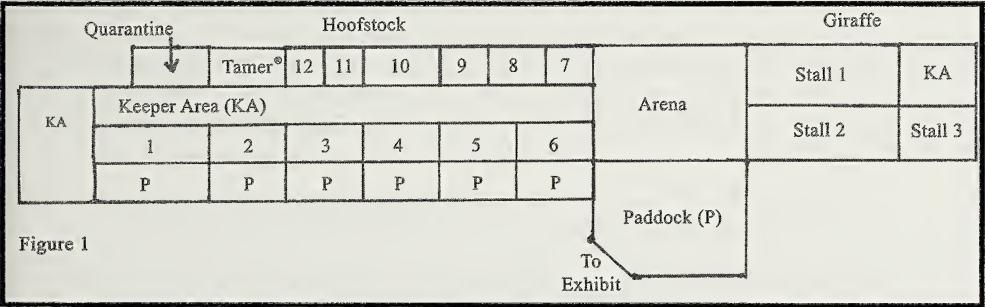
# Caring for African Ungulates in a Winter Climate

By Maureen Miller, Large Mammal Keeper  
The Toledo Zoo, Toledo, OH

How do we care for ungulates, native to Africa, in a climate that receives on average 35 inches of snow, with temperatures at or below freezing for at least four months out of the year? What is the optimal way to house our hoofstock collection to ensure their physical and mental needs are being met? These are questions we face when December rolls around and we house our African Ungulate collection inside our winter barn.

## The Basics

Currently, our collection consists of 2.2 Masai giraffe (*Giraffa camelopardalis tippelskirchi*), 1.0 Grant's zebra (*Equus burchelli*), 2.0 white-bearded wildebeest (*Connochaetes taurinus*), 0.2 greater kudu (*Tragelaphus strepsiceros*), and 1.5 impala (*Aepyceros melampus*). From March/April (depends on weather and yard condition) to December, they are exhibited on a grass pastured 4.4-acre mixed-species exhibit. From January to March/April, they are housed inside our winter barn. Our giraffe barn consists of two main stalls approximately 40ft. x 25ft. [12.19m x 7.62m] and a third stall approximately 20ft. x 20ft. [~6m x 6m]. Our hoofstock barn consists of 12 stalls. We have two sizes of stalls, six are approximately 18ft. x 24ft. [5.5m x 7.3m] with attached outside paddocks that have radiant heaters. The other six stalls are approximately 14ft. x 16ft. [4.26m x 4.87m]. Both barns share a heated exercise arena, approximately 40ft. x 40ft. [~12.2m x 12.2m], with an attached outside paddock. Figure 1 shows the layout of our barns.



We have two routines that define the function of our barns. The first is the summer routine and runs from March/April until December. During the summer routine, giraffe, kudu, and zebra come off-exhibit every night. Impala and wildebeest spend the entire summer season on exhibit; they are not asked to come inside at night. Our male wildebeest, due to their territorial nature in confined spaces, must be separated if inside our barn. For our impala herd, the male must be separated out inside our stalls, as he tends to be pushy around the females. So, for both species, we feel it is better to manage them as one large herd, together, rather than having to constantly separate them if they came inside. During the winter routine we have all species inside our winter barn. For our giraffe, we house our male separately from our females. However, they are still able to interact through chain link fencing that separates their stalls. Most of our hoofstock species are housed as species-specific herds. Once a week we house our impala and kudu together in our exercise arena as enrichment for them. And as mentioned earlier, we house our two male wildebeest separately during the winter due to their territorial nature in confined spaces, but our shift doors allow us to howdy them so they can still interact with one another.

## Daily Routine

Our day starts like many keepers by checking all of our animals to make sure they are bright and alert. We formulate a plan for the day that typically includes cleaning, training, enrichment, and other area projects. Weather obviously plays an important role in our day; it is the first factor in deciding how to attack the day's work, especially when snow removal is at the top of the list! The first item we evaluate is ground condition. Our paddocks must be free of ice and any packed snow before we allow our ungulates to have access to them. Next, we evaluate wind chill, sky conditions (sunny, cloudy, raining, snowing, etc.) and the threat of storms. Finally, we evaluate overall temperature. Our

barns both maintain inside temperatures between 60-65°F [15.5-18.3°C]. The outside temperature guidelines we have established are appropriate for our collection and we encourage other institutions to form their own guidelines. Our guideline decisions were determined after animal care staff and veterinary staff, in consultation with other institutions, considered our animals' histories, herd structure (i.e. age of adults, females with calves, etc.), climate, and holding areas. The guidelines are follows:

- Hoofstock can be locked in, heated, outside paddocks if temperatures are 32°F [0°C] or above for approximately one hour.
- Adult giraffe can be locked outside if temperatures are 45°F [7.2°C] or above for approximately one hour.
- An adult female with calf can be locked outside if temperatures are above 55°F [12.8°C]. We slowly increase the amount of time the calf is exposed to cooler weather in order to allow its body to adjust to the fluctuating temperatures.
- If temperatures are hovering around the above guidelines and outside conditions include rain, freezing rain, hail, snow or high winds, animals are not locked in any outside area. However, if outside conditions are suitable, our ungulate collection can have outside access if temperatures are below the pre-mentioned degrees, as long as they have access to a heated indoor area (i.e. stall or arena) as well.
- Before locking any of our ungulate collection outside we make sure to allow the animal time to acclimate to the colder weather. This is accomplished by slowly increasing the amount of time they spend in temperatures below 55°F [12.8°C]. We also adjust our guidelines for new animals, especially those from warmer climates.

So how do we determine when to shift animals on/off exhibit for the different seasons? We follow the following guidelines:

- For animals that live on exhibit during the summer months, the temperatures must stay above 32°F at night before they are shifted on exhibit in March/April.
- All animals come off exhibit when temperatures start falling below 32°F at night.
- When the temperatures are low, in the spring/fall, and we have animals on exhibit, they have access to our heated (if necessary) exercise arena and two stalls set at 55°F, regardless of weather.

All of our stalls are stripped and cleaned on a daily basis. And we usually get all of our cleaning done before turning our attention to training or other projects. When the weather does not permit our animals to be shifted into paddocks to clean, we shift animals into the exercise arena or another animal's stall. We try to keep the animal's winter routine similar to their summer routine, minus the warm, sunny days filled with green grass of course! What I mean is we will feed grain out at the end of the day in the winter, because that is when they would receive it once they shifted off-exhibit in the summer. Or when shifting our kudu from one area to the next, we cue them with a cowbell first, and reward with lettuce, as this is how they are cued to come off exhibit during the summer. We are also currently looking into growing plants indoors during the winter months in order to provide our ungulate collection with fresh greenery year-round.

## **Training**

Most of our training is done during the winter, when we have access to our animals throughout the day and we can manipulate them more easily. We train new behaviors during the winter and maintain behaviors throughout the summer. We conduct training sessions with our giraffe on a daily basis, and as scheduling allows with our hoofstock. Our goal for any behavior we begin during the winter is to have it completed by March, so that we can transition the behavior to a maintenance schedule for the summer. We also try to work on multiple behaviors, at varying levels of difficulty, to ensure the animal (and keepers) remain interested in training.



The behaviors we work on during the winter are determined based on the need of a particular behavior for an animal or group of animals. We make sure to work on "basic" husbandry behaviors (i.e. weights) before moving on to "advanced" behaviors (i.e. blood draw). Currently we are able to obtain weights on all of our collection and individuals are either target trained or trained to stand in a restraint/chute device. Behaviors we are currently working on include blood draw, hand-injection, ultrasound, and hoof trimming. Most of the keepers in the area have never trained hoofstock before so we are learning right along with the animals. It has made training challenging but even more rewarding when a behavior is accomplished.

## **Enrichment**

The goal of our enrichment program is to encourage our animals to stay active while inside; this helps keep them in good physical condition, and mentally stimulated throughout our winters. Our animals receive enrichment on a daily basis (sometimes multiple times) which is recorded in a notebook. Like many institutions, we have a variety of toys we offer our animals; most are horse toys (i.e. Jolly Ball®, Pasture Pal®, Boomer Balls®, etc.) but a few items we have made ourselves. Some of those items include: bamboo chimes, PVC jacks (sparring structures), and fire hose browse hangers. We also try to get multiple uses out of seemingly "everyday" items; some examples include: hanging cardboard wrapping paper tubes as sparring structures; and hiding hay/treats under extra feed pans. We also try to provide a lot of non-food based enrichment. Examples include: mounting brooms, brushes, or black mats as scratching posts; sprinkling different scents and spices around; playing animal or nature sound CD's; rotating used browse through different groups of animals; and bringing in snow (or other substrates) for our animals to investigate. Sometimes enrichment can get pretty fancy but just simply breaking up long winter days by feeding multiple times or scattering food through multiple areas is enough to keep our guys happy and healthy.

One item we find very versatile, and that our animals love, is browse, and we continue to offer it throughout the winter. We find our animals still play with, strip the bark off, and chew on the sticks, even though the leaves are absent. We can also use the sticks as a starting point for other enrichment (i.e. lettuce trees, fruit kabobs, jelly smears, etc.). When hung in large bunches, it also makes for some interesting sparring structures for our horned animals!

## **Barn Features and Creature Comforts**

Our barns have several features that allow our ungulate collection to be comfortable during the winter months. One of the best features we have is our exercise arena. This area, approximately 40ft. x 40ft., gives us a lot of flexibility when it comes to shifting animals to clean, train, or simply for a change of scenery. We have a rotational schedule to ensure that all animals receive time in the larger area. We utilize it at night, as well as during the day, to allow the animals more time outside of their stalls. The arena features a substrate consisting of a sand/fine gravel mixture (called screenings), two radiant heaters, and an attached outside paddock.

Throughout the barns we have floor heat, overhead heating units, and radiant heaters in all of the outside paddocks. All of our stalls have textured floors to help keep hooves worn down. Shift doors to and from all stalls and paddocks allows us many options for housing and rotating animals throughout the stalls. Each of our stall doors have windows cut in them with the added benefit of peep holes so, when needed, we can monitor animals without disturbing them. Additionally, skylights throughout provide a lot of natural light.

In order to alleviate stress on our animals' joints, we provide multiple black rubber mats and screenings in all outside paddocks. All stalls also receive wood shavings as bedding on a daily basis. We also installed cables and/or added extra attachment points around the stalls so we can hang enrichment.

## **Final Thoughts**

Caring for African ungulates in a winter climate can be challenging. As keepers, we rely on having strong relationships with the animals in our care. Having our hoofstock in our barn for at least four months out of the year allows us the opportunity to establish extremely close relationships with them. The animals teach us their likes and dislikes, their personality traits, and much more. On the flip side, we learn how to best meet their needs through training and enrichment. We do our best to provide the best possible care for animals not accustomed to a climate with snow!

## Rearing Antelope:

### Three Thriving Examples at the Saint Louis Zoo

By Christy Poelker, Senior Keeper/Ungulates  
Saint Louis Zoo, St. Louis, MO

The Saint Louis Zoo has had tremendous experience in managing challenges with neonatal antelope. From 1988 to 2010, 25 animals were successfully hand-raised by the Antelope Unit staff of the Saint Louis Zoo, including three lesser kudu, eight Speke's gazelles, and two Mhorr gazelles. Every effort is made to give a mother the opportunity to raise her calf, but sometimes even the best conditions do not lead to a mother that is willing and/or able to care for her offspring. Calves receive the best nutritional and social support from their dams, but when it is absolutely necessary Antelope Unit staff has a great background of knowledge and experience from which to draw. In 2007 and 2008 we successfully cared for three animals that required supplemental feedings and extra care. In May of 2007 a Speke's gazelle (*Gazella spekei*) was not comfortable with caring for her first calf. We provided the calf with bottles while integrating him into a normal social setting. We also took steps to ensure that his dam would be well prepared to take on her role as mother the next time she calved. She successfully cared for her second calf, and her first calf lives in a herd where he exhibits normal Speke's gazelle social behavior.

In November of 2007 we encountered a similar situation with a Mhorr gazelle (*Gazella dama mhorr*) and her first calf. He is also integrated into a herd, with some guidance from a herd mate that was an experienced mother acting as a role model and surrogate mother. In March of 2008 a lesser kudu (*Tragelaphus imberbis*) calf was born via caesarean section from a first-time mom. We gave the calf supplemental feedings while her mother healed from surgery and began producing enough milk to sustain the calf. We also helped the calf initiate nursing bouts by encouraging the dam to stand still for her calf to nurse. All of this hard work led to the mother eventually raising the calf on her own. The challenges we have overcome can be a valuable example to others who may encounter similar experiences with antelope calves in the future.

A two-year old Speke's gazelle named Sprout calved for the first time on 5 May 2007. Despite being mother reared herself and having lived in a breeding herd where she witnessed other mothers caring for their calves, she was not comfortable with her role as a first-time mother. She delivered her calf in the morning when keepers were in the barn, which is unusual compared to most of the other over 150 Speke's gazelle births that have occurred at the Saint Louis Zoo. Sprout did not clean her calf or show any interest in him. In fact, when the calf made attempts to nurse, Sprout discouraged his approach by putting her head down to him. Using time-lapse video surveillance and watching the mother and calf on a remote monitor, the Antelope Unit staff kept close watch over the pair for the rest of the day with hopes that the calf's persistence would pay off and his mother would become more comfortable with him and allow him to nurse. By 24 hours of age the calf had not been able to nurse and the decision was made to offer him supplemental feedings.



Bean and the author.  
(Photo: Diane Wilson)

The calf, Bean, adapted quickly to feeding from a bottle, but we wanted to be sure that his social needs were met along with his nutritional needs. We also wanted to give Sprout the opportunity to become more tolerant and less fearful of the calf. We wanted to give her positive exposure to the calf so that she would raise future offspring. She was offered two stalls during the first few days during feedings so that she could move away from Bean when he got up to take his bottle from keepers when they entered the stall. After she got used to the routine she



was left in the stall while keepers entered and fed the calf. She slowly became comfortable with the calf being around and keepers entering their stall several times a day to feed him. We did not want to give her the impression that if she was scared of the calf she could just walk away from him and the keepers would care for him. We wanted her to be as involved as she could tolerate and learn that the calf was not anything to be afraid of.



Speke's gazelle calf Bean (Photo: Diane Wilson)

On 11 May 2007 Sprout and Bean were moved to a stall adjacent to an experienced Speke's gazelle mother and her three-day-old calf, so that they could have visual access to one another. After several days of visual access we introduced Sprout and Bean to the other mother and calf. Sprout still did not display any maternal care for Bean, but she had become much more tolerant and comfortable with him being around. This time also allowed her to watch the experienced mother take care of her own calf. At this time Bean was also given some daily outdoor time with a keeper. We let him investigate an outdoor habitat while providing him

some sunshine. He would then follow us inside to rejoin his mother.

By 31 May 2007 we felt confident that Sprout had been given an adequate amount of time to associate calves with a positive experience. We moved her back to her former breeding herd so that she could become pregnant again and give motherhood another chance. Meanwhile Bean thrived in his new herd that by June included a second experienced mother and her new calf. He continued to be fed by bottle but he socialized with the other two calves in his herd and was under the watchful eye of their mothers. Bean was given his last bottle on 21 September 2007. He had grown from 1.39kg (3 lbs. 1 oz.) at birth to almost 8.18 kg (18 lbs.) at his last supplemental feeding. By 30 November 2007 he was ready to start his new life in a bachelor herd. He was socialized with another male Speke's gazelle that was four months older than him, and their interactions were typical of other bachelor males.

Bean lived in a bachelor herd of Speke's gazelles in a habitat with lesser kudu and saddle-billed storks (*Ephippiorhynchus senegalensis*) until his transfer to another zoo. He exhibited normal gazelle behavior. He was calmer than his herd mate, but he did not have much interest in interacting with his keepers. Bean's mother Sprout calved again on 3 December 2007 and took great care of her second calf. Bean now lives with his herd mate and rhinos and is doing well.

A similar situation occurred with a Mhorra gazelle later in 2007. A hand-raised first-time mother, April, gave birth to a male calf, Marston, on 27 November 2007. Similar to the Speke's gazelle mother, April also would not allow the calf to nurse, was fearful of him and displayed inappropriate behavior toward him. We offered him supplemental feedings and hoped that his mother would begin to display maternal behavior. The Antelope Unit staff scheduled time for the pair to be monitored by a keeper while they were together during the day, since leaving them alone together could be unsafe for the calf. We hoped that in time she would calm and tolerate the calf. Unfortunately, she continued to display inappropriate behavior and seemed preoccupied with the other two females in the barn. On 5 December 2007 we decided to put April with an older female, Sug, who had raised her own calf years earlier. We thought that April would be calmer with another gazelle in the stall with her. The support that "auntie" Sug provided turned out to be invaluable. Sug not only helped to calm April, but also was very interested in Marston and was often observed grooming him.



Speke's gazelle Bean and his herd mate. (Photo: Kate Reed)



By 8 December 2007 Marston was able to live with Sug at all times unchaperoned. We continued to socialize Sug and Marston with his mother April during the day with supervision. Once we felt confident that this new herd was getting along they remained together at all times. Most of the time Sug and Marston were in close proximity to each other and April was by herself, but at least she was tolerant of the calf and could watch how patient and caring Sug was toward him. During this time, unlike most experiences we have had with bottle-fed antelope, Marston would refuse bottles. He was witnessed eating solid foods on his own at a young age and close monitoring of his weight and health revealed he was doing well on his own. In fact, he basically weaned himself at a younger than typical age. He was able to live in a herd with his mother, his surrogate mother Sug and another adult female. He was usually much more interested in interacting with the other gazelles than with the keepers. Unfortunately, April chose not to raise her next two calves as well. But since we had a protocol for this situation, we were able to socialize them much more quickly. And hopefully all of the time spent observing interactions between her calf and Sug will give April the tools she needs to be a great mother to her other calves.



Mhorh gazelle calf Marston.  
(Photo: Kate Reed)



Marston with his mother (Photo: Kate Reed)

The experience we had with a female lesser kudu calf was quite different from the previous examples. It involved a mother willing to care for her calf, but unable physically to take on the role at first. First-time mother Blossom went into labor on 23 March 2008. Contractions and fetal movement were observed all day. By the next afternoon the veterinary staff determined that the calf was malpositioned and a caesarean section was performed. The 5.95kg (13.1 lbs.) calf, Hadiya, was healthy, but had to be cleaned and warmed by Antelope Unit staff while her mother recovered from anesthesia. The calf was returned to her dam as soon as possible, but understandably Blossom was sore and tired from the surgery. She showed no interest in her calf on the day she was born, but we hoped that after some recovery time she would care for the calf. By the day after the surgery Blossom was showing some interest in the calf but would not stand still for her to nurse.

We bottle-fed the calf to sustain her but tried to make sure she was somewhat hungry so that she would continue to attempt to nurse from her mother. We judged how much to feed her based on her behavior and her weight, which was taken each morning. When Hadiya was two days old, Blossom began to stand still for short periods of time for the calf to nurse. Antelope Unit staff kept a close eye on the pair using time-lapse video equipment. Keepers would review the tapes before each bottle-feeding to keep track of any nursing attempts or maternal behavior. The video equipment was an extremely useful tool during this time. If we had not seen their behavior on tape we would not have known that they were making subtle progress toward a normal mother-infant bond. We may have had to resort to fully hand-raising the calf had we not had this useful information. Having the video equipment set up several stalls away from the pair also allowed us to monitor them while not



Hadiya just after she was born.  
(Photo: Diane Wilson)



interrupting crucial nursing and bonding time. At this time we also began helping Blossom to stand still for the calf. We would enter the stall and encourage her, often by tossing her some bread, to stand still long enough to let the calf nurse. Blossom began interacting with the calf and piddling her, but she still was not reliable about letting the calf nurse. Although this process was time-consuming we believed that after Blossom had some time to heal she would care for the calf.

After five days of intensive management, on 28 March 2008 we were encouraged enough to begin to offer the calf half the amount of milk that we would offer a fully hand-raised calf, so that she would remain hungry enough to continue to seek milk from her mother. The next day we also began to offer her water bottles after her milk bottles since blood work revealed elevated kidney values. We realized that offering her water bottles stimulated the calf to go to Blossom to nurse. By 30 March 2008 our new routine with Hadiya really seemed to be working. Several times a day a keeper would watch their tape and record any nursing, and then they would open the door of their stall just wide enough to offer her a milk bottle. Hadiya would consume the milk in the bottle and then usually nurse from her mother after her bottle while the keeper timed and recorded the length of the nursing bout. When she would walk away from her mother we would barely open the door again to offer her a water bottle. She would drink the water and then again run to nurse from her mother. This routine continued until 9 April 2008 when at 7.82kg (17.2 lbs.), and a clean bill of health from the veterinary staff, we fed her a last bottle. We continued to weigh her daily until she was 24 days old to ensure her mother was able to feed her sufficiently on her own.



Hadiya nursing from her mother.

(Photo: Diane Wilson)

Hadiya was transferred to another zoo in June of 2009 per a recommendation from the Lesser Kudu SSP®. It is hoped that soon she will raise a calf of her own. Her mother Blossom has since had two more calves and observing her maternal behavior with both of them you would never know that we had to help her at one time.

While providing proper nutritional support to a hand-raised antelope calf is important, it is also vital to ensure a healthy social experience for the calf. This gives a calf the best possible chance of exhibiting normal behavior in the future that is important for animals that must learn to live in a herd and interact appropriately with keepers. It also allows the calf's immune system to benefit from the nutrition of its mother's milk. Sometimes the best laid plans need to be adjusted to accommodate the specific needs of each neonate. It is also important to consider the needs of the dam so that she has the best circumstances in which to choose to raise her calf. The decisions made when caring for a calf that is not being mother-raised can have implications for subsequent calves from the same dam. It can be more time-consuming to monitor calf-dam interactions, but it may prevent staff from having to intervene with future calves. The commitment of the Antelope Unit staff at the Saint Louis Zoo has helped to ensure that a lesser kudu got the best start in life by being fed and nurtured by her mother, a Speke's gazelle learned to care for her second calf after being too nervous to raise her first one, and a Mhorraz gazelle was mentored on appropriate behavior toward a calf by her herd mate. The staff's efforts are rewarded by the species-appropriate and socially acceptable behavior of each of these formerly special needs individuals.

### Acknowledgements

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# Walking a Mile in Their Hooves: Managing Desert Bighorn Sheep (*Ovis canadensis mexicana*) in Natural Exhibits

By Devorah Young, Senior Keeper/Hoofstock Trial  
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## Abstract

Climbing and running away from danger is the Bighorn Sheep's first line of defense. Constant access to mountains makes managing captive Desert Bighorn Sheep a challenge. At the Phoenix Zoo we have two large exhibits with large buttes, containing two separate herds. Over the last five years, we have pursued safer ways of managing the herds of Bighorn by socializing with them and training them through operant conditioning. We have had to overcome setbacks brought on by naturally skittish animals having the choice to not approach, rut seasons, and other challenges that come about with such large exhibits. But with perseverance we have had much success with both herds. We have had the ability to conduct public/private tours, herd station training, and advancement in training programs overall. This paper will present how we manage Bighorn Sheep herds in natural exhibits with emphasis on their training programs.

## Introduction

What started in 2006 as a way to better manage a small herd of desert bighorn sheep (*Ovis Canadensis Mexicana*) has turned into a way of life for not only the Bighorn but for their keeper staff as well. Gaining the trust of a prey species is not easy. When discussing Bighorn that have access to mountains for retreat, things get even more complicated. We focused on the more social animals first and began the process of teaching them it was acceptable to trust people. We had to walk with them, sit with them,

and most importantly become part of the herd. In 2006 we had a yearling ram being dispositioned for breeding and none of the animals, except for our breeding ram, would readily shift into the holding yards. This prompted an ongoing journey of socializing and gaining the trust of these naturally allusive animals.



Bighorn sheep herd at Phoenix Zoo

(Photo by Devorah Young)

## The Herds

As of 2011 we have 20 Bighorn Sheep in two different exhibits. The Main Butte holds 8.5 Bighorn, including two ewe lambs, one ram lamb, one breeding ram, three breeding ewes, five castrated rams, and one yearling (intact) ram. The Back Butte holds 1.6 Bighorn, including one castrated ram and six ewes (most of whom are

directly related to the breeding ram on Main Butte). Staff has free contact with all of the Bighorn except with the breeding ram "Truman", that is in mandatory protective contact. Truman does not have the normal apprehension with people that a Bighorn would have. He considers those of us that he knows as conspecifics and would injure us even in "play". He is very protective of his surroundings and chooses to defend his territory instead of running away from any perceived danger. All of the other Bighorn will quickly run up the buttes for safety.

Both exhibits have 8-10ft. chain link fencing around the perimeter as well as chain link fencing segregating the holding yards in each exhibit. The Main Butte is ~three acres of space with a 200ft. butte in the middle with a public viewing deck at the front of the exhibit. The exhibit has multiple native trees and shrubs throughout, two water sources toward the middle and front, and two holding yards located in the back. The Back Butte is ~ one and one-half acres of space with a 200ft. butte



towards the front of the exhibit and is considered an “off-exhibit area” with no official public access or up close viewing. This exhibit has some native shrubs throughout, one water source in the front, and two holding yards also in the front.

The Bighorn exhibits not only face zoo property but are also on the perimeter of the zoo itself, adjacent to a park, which people use for many recreational activities. Wild coyotes roam free, horses are ridden, dogs are walked, and celebrations and other festivities are held right in their backyard. Almost all of the aforementioned are enough to cause the herds to spook, run up the buttes, and away from us, sometimes making daily husbandry a difficult task.



The Buttes  
(Photo: Devorah Young)

### Gaining Trust

When discussing “the herd” we are talking about all of the Bighorn on the Main Butte except Truman, whose management and training will be discussed separately (the “Back Butte herd” will be mentioned separately as well). We realized right away that the herd was not only hesitant about people, but very leery of the holding yards and even though their breeding ram shifted every day, as a herd they were not going to follow without some coaxing. We had an opportunity to become closer to a yearling ram earlier in his life when his dam died when he was only one month of age. He was partially hand-fed his daily hay and pellet rations to ensure

proper consumption and close monitoring of body condition due to not yet being of weaning age. His trust, that grew over many months, led his ewe sibling to start approaching us and then a semi-social older ewe followed soon after. It would be these three sheep that aided in the trust of the 2006 herd as well as all of the animals we currently house. We introduced a white bucket as their visual cue for food. We carried their grain pellet ration in this bucket as we walked them toward the back holding yard area. We started calling for them as we approached the exhibit, and after only three days the herd followed us to the back holding yards. The more elusive Bighorns stayed farther away, but stayed close enough to the others to learn this new routine. We did not and currently do not lock the herd (except for Truman) in the holding yards unless necessary, because of the skittishness of the animals.

The yearling ram was successfully transported from the Main Butte to our Animal Care Center to prepare for his disposition date. We had to continue to walk the herd to the back for awhile before they started waiting for us at the back of the exhibit. Even now there are some days, due to weather, outside stressors, noise level, etc... that we have to walk them to the back, but most of the time they will approach the holding yards on their own after they hear us calling for them. They have learned to trust those they know but will react differently to strangers; sometimes looking to us for reassurance and other times even defending us against those they perceive as a threat.

Every day with the Bighorn is a “work in progress”. Some days they are already on “high alert” when we arrive and will not respond to our requests, while other days the weather deters them from coming down off the buttes, and then there are the days that we encounter a very excitable (and sometimes aggressive) breeding ram in rut.

### Our Breeding Ram

Truman came to us at one year of age in 2004, already showing signs of fearlessness and high energy. By age two we realized we could no longer have free-contact with him and started conditioning him with a small amount of food to shift into the back holding yards. He caught on quickly but had other ideas and found ways to crawl out from under the gates to be back on exhibit with us. Modifications were made and luckily his horns grew too large to squeeze anywhere anymore, but now he could ram and break things. This was also the same year he started breeding, his first rut season, and the start of many exhibit modifications. With each rut season his excitability and aggression has increased,



which at times has made shifting him and working with him difficult. It wasn't until 2007 that we started his formal training program that included both target training and bodywork. During the majority of his training session he has the choice to walk away and be on exhibit with the herd; sometimes he does just that but the majority of the time he chooses to stay and be trained. He enjoys human contact and will seek it out whenever possible, which helped greatly with his training since overcoming any apprehension towards us was not an issue. His first target was a tennis ball on a pole. He quickly learned that the tennis ball would be his target and his alone. We changed it to a tennis ball with a hook so we could hang the ball along the fence and have our hands free



Truman in rut 2010  
(Photo: Deborah Young)

for rewarding him. Years later, this also helped us teach him to station even when we were some distance away. We learned fairly quickly that if the tennis ball was visible he was in "work mode" and would focus on that ball and not give any other behaviors. His bodywork was a bit slow of a start due to us trying to figure out how to ask him for his "side" on cue. A hairbrush became our visual cue as well as the reward for tactile work and he caught on rapidly. We also learned that food reward was good for target and station training, but that it was too distracting for the tactile work, so the tactile work became its own reward. In 2009 we successfully performed a standing blood-draw with our Veterinarian while he had the choice to walk away from us (even after being poked a couple of times). We were also able to do basic physical exams by cueing him to present each of his sides to our vet.

The only time of year that his behaviors are sporadic and unknown is during the rut, which for Desert Bighorn Sheep can be from July through November. During these months training is at its minimum and we arrange our sessions around his willingness and calmness with us. When he is breeding the ewes he does not shift at all and a different protocol goes into affect for everyone's safety. This is also the time when he does the most damage to himself (broomed horns, loss of appetite, aggressive toward conspecifics, and destruction of the exhibit).

As the herd grew so did their curiosity in what we were doing with Truman, and one by one herd members started mimicking Truman's behaviors near his target. Their official training started in 2008 with a couple of the younger rams and by 2009 we had some of the ewes and more rams wanting to train. We never force them to train, they have to choose to approach us at the fence and start taking food rewards from us.



Tactile work on Truman  
(Photo: Hilda Tresz)

## Challenges

Because both herds live on such large exhibits, they do not always feel safe to approach or even come down off the buttes. They may choose to stay away from us, approach for food only after we exit the area. We were determined to become a part of their lives and to gain their trust. But with trust comes rules and unfortunately sometimes we have had to break those rules in order to properly care for them. We have had to separate many for medical procedures, relocation to a different butte or a different zoo altogether, and we have had to climb to retrieve neonates for exams or sometimes to retrieve deceased animals. Many of them seem to hold grudges and would not approach for days, even weeks, post "traumatic events". We went back to square-one many times in order to gain their trust again; this occurred with individuals and sometimes as whole herds. Since the two exhibits are close to each other, when one herd is alarmed the other follows suit and will behave accordingly. For one and a half years we had a young ram stop his training with us after his castration and then, out of the blue, decide it was safe again. We have lost animals from illness or injuries, due to their shyness and instincts, when they retreated and segregated themselves from us and the herd, not allowing help until it was too late.



We compete with not only their natural instincts but also all of the outside stimuli that they have access to. They have visual over the entire zoo and into the surrounding cities with 360-degree views from the tops of their buttes of the Phoenix Metro area. We truly depend on the relationships and bonds we have formed with them in order to manage them effectively. It is important to mention that rams are not hand-fed in free-contact in order to keep respectful relationships with them. We do hand-feed ewes in free-contact whenever they allow it, in order to make stronger bonds with them and their offspring. We rely on the ewes each year to teach their offspring that we are okay to be near. It has taken years to have some of the Bighorn, in both herds, to approach us for anything, let alone training. We have also “burned bridges” with some of them and we are still working on getting those relationships back.

**Successes**

As of 2011 we have 14 Bighorn on training programs; some are target/station training (each Bighorn has their own target), others are tactile training. Since each Bighorn has its own personality and trust level with us, we work with them as individuals as well as a herd. We were very surprised when our shyest ram on the Main Butte showed interest in the sessions and started approaching closer to us on exhibit. In March 2011, he started to watch the herd while they trained and a couple of weeks later approached the fence and took food from us. At this time we started to station train this group as a herd, all at the same time. It was chaotic at first since they were all on different levels of training but after only about two weeks we had a Bighorn herd successfully station-trained. Currently the herd is trained on exhibit, and our goal is to also train them in the holding yards in order to keep them calmer in smaller spaces. There is little if any literature on ungulate herd training and therefore the Bighorn are teaching us just as much as we are teaching them. A new challenge may arise that we have to overcome but we do it as “one of the herd”, trying to work with them not against them. The Bighorn live very natural lives, growing into strong animals with keen instincts, but also accept us into their world.



Herd learning cues  
*(Photo: Stephanie Edling)*



Herd stationing  
*(Photo: Devorah Young)*



We have witnessed some very interesting behaviors that would most likely not be seen in the wild. Our 2009 lambing season only produced one lamb, a little ewe that Truman became very protective over; he was seen standing over her at the top of the butte when she was less than a day old. Because of this strong bond, she learned target training at an early age watching alongside Truman and this helped us with her immobilization and move to the Back Butte. Another intriguing display occurred during the 2010 lambing season with our castrated rams. Our skittish ewe did not reunite with her lamb after the neonatal exam for most of the day; consequently throughout the day, multiple castrated rams would stand over him, shading him from the sun, resting beside him for safety. Fortunately the dam accepted her lamb during the night and it is thriving as our current yearling ram. During our recent lambing season we witnessed some of those same rams actually helping to clean newborn lambs and protect them while the dams ate. Normally rams and ewes would not be together this time of year so this is not "normal" behavior but we have witnessed true cooperative care for the sake of the entire herd, which is amazing to observe.



Cooperative care of calf

(Photo: Deborah Young)

### The Future

The Back Butte herd has also accepted our presence and all of the ewes are now on training programs and we hope to start herd stationing with them by late 2011. We will focus on their matriarch, that just recently started to approach for training, since she will chase away the others. Unlike Truman, most of the herds' members do not want to be touched; therefore tactile work will be done on an individual basis when allowed. We have an older ewe that tolerates tactile work and as a result we will continue her training once she is approaching again with her new lamb.

We plan on encouraging all of our Bighorn to live as naturally as possible yet still allow us into their lives in order to help them achieve longevity. With such large exhibits to live in, we try to be one step ahead of possible issues, ready to change protocols, and always expect the unexpected. We will continue herd-training with whichever individuals would like to participate. Truman's work is always ongoing and because of yearly interruptions due to rut, sometimes we have to move backwards in order to move forwards.

### Conclusion

Persistence and perseverance are keys when working with animals. When working with Bighorn Sheep, a mutual respect must be achieved for safety and progression. Operant conditioning helps bridge the gap that nature has made between Bighorn and humans. When working against nature, asking animals to trust, become vulnerable in our presence, we have to accept that not all things go according to plan. Bighorn Sheep are smart and inquisitive but very cautious and if given the choice they prefer to "do as the herd does". When wanting the whole you may have to focus on an individual first. Setbacks must be accepted and learned from, while successes (big or small) must be relished.

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# Ungulate TAG Meetings and Conferences: We Want You!

*By Matthew Ardaiole, Lead Hoofstock Keeper  
Potawatomi Zoo, South Bend, IN*

Conferences are something we all know occur and a lot of us seriously consider actually attending one. However, it seems that something always comes up; I don't have the money, I have something going on that week, I'm too busy at work, I don't know if I would really enjoy myself anyway. Well, this past March, I managed to motivate myself, scrounge up enough of my own money, ask my boss for the time off, and make it down to Chattanooga for the AZA mid-year conference. And let me tell you, it was worth it.

It is very easy for us, as zoo keepers, to get caught up in the day-to-day routine of checking on our collection, feeding, training, scooping, scrubbing, and dumping, and finally finishing the day by feeding-out (let's not forget the paper work!). However, there is a lot more going on out there in the zoo world that most of the keeper professionals have no idea is occurring. Unfortunately, there is only one person to blame for that, and that's the keeper.

In Chattanooga, my eyes were opened. Not only did I get to meet new people (mostly curators, researchers, and managers!), participate in discussions (as a keeper?!), visit some wonderful institutions, and eat great food, but I also learned. I learned about how we have people in the field helping with the set-up of poaching patrols. I learned how we are using our people to open up the country's borders to exotic hoofstock to replenish our gene pool. I learned how we are contributing to the success of the pronghorns in Baja. I learned how research into breeding herds and bachelor herds will most likely one day save the creatures we adore that have hooves instead of digits, and oh boy, did I learn about sustainability.

Only one thing can truly make the concept of a zoo work - communication. We expect ourselves to be able to manage exotic animals that, honestly speaking, most of the time we don't know much about. We rely on discussions with other keepers, Animal Data Transfer Forms, publications, ingenuity, and a bit of luck to continue, on a day-to-day basis, providing the best care we can. However, there are far more efficient ways to learn, and I suggest attending these conferences. Meeting with the TAG representative of a species is the most enlightening experience you can have for that one species. They are the representatives of that particular animal and have all of the knowledge about it at their fingertips just for you (whether they like to admit it or not). Everyone turns to them for the answers and you can too. Meeting them in person is the best way to open up the lines of communication that you need to make what you do a success. During one seminar at the Chattanooga meeting, I learned about urine phosphate levels and the distress it can cause in ungulates (this one, specifically dealing with giraffes) along with research being done with it. I hope, down the road (once I can train bison and pygmy goats to urinate in a cup) to be able to submit samples to assist in the research, since I have seen similar urinary blockage issues in these species. To further add to the benefits of talking with the TAGs, you may just teach them something new about their species that they may not have known prior!

Most keepers aren't aware of the issues that the entire zoo community is facing everyday and that's the issue of space availability. Ungulates have lost about 1000 spaces in zoos over the last decade. The issue of sustainability within our collections is fast becoming, if it hasn't already, the most critical issue of zoos worldwide. There are already several great ideas circulating throughout the community. However, more communication (there's that word again!) on the subject is greatly needed. Internet and telecommunications are great, but it's when people get together in one room and start talking and discussing that brings up the best ideas. Specifically at Chattanooga, I learned from the collared peccary (*Pecari tajacu*) TAG that when my institution acquired 1.2 collared peccaries a few years back, this opened up crucial space for another institution to acquire the much more endangered Chacoan peccary (*Catagonus wagneri*). Unfortunately, not every institution in the country can hold every endangered animal and breed them. The institution that acquires animals for holding is just as important as the institution that acquires animals for breeding. In addition to this, I learned that when I decided introducing three more peccaries to our group would be a bit more troublesome than what I ignorantly thought was worth it, I unfortunately decided against another institution being able to also acquire chacoan peccaries since they could not phase out their collared peccaries. By sitting in on this meeting, it dawned on me why it is so important to follow the recommendations that are sent





1.1 Collared Peccaries (Spike and Truman)  
at Potawatomi Zoo. (Photo: Matthew Ardaialo)

to us by all of the SSPs®. Hopefully, now my institution can look into the recommendations for introducing collared peccaries so we can look into establishing a bigger, non-breeding group.

Learning what our managers are doing on a day-to-day basis is another vital issue that many keepers face. The keepers, as we all know, are the ones out there keeping the exhibits looking nice and providing the best care we can to our animals. Through the blood, sweat, and tears (you know, when that hose kinks again), we are one dedicated group of people. And I know, because I'm guilty of it myself, that often times, maybe while we're cleaning up that umpteenth pile of poo, we wonder to ourselves what our managers are actually doing in their

air-conditioned offices. Or wonder why they're asking us if we can fit any more animals into our already busy schedule. Or ask us how we would feel about introducing a few more of a species to an already stable group. I learned that many questions that require immediate attention, as far as sustainability, are at that forefront of many of our managers' minds. Learning what ideas are coming from our managers to improve the zoo community is an eye-opening experience. It really gives you more of an idea of what is going on in that office and what is taking place in those emails you always see them sending off, or why your manager always seems to be on the phone. It also allows you to gain more respect and appreciation for what is being done all around you. Conversely, managers also gain more respect for keepers once they see them attending these conferences and learning about the ideas that are floating around in their heads.

As we all know, age distribution pyramids are often used for tracking populations. These maps show the entire age span of the total population of a species. Of course, we would prefer to see an actual pyramid take shape when tracking these distributions. However, more often than not, these distributions take the forms of trees, inverted pyramids, or spoons. Unfortunately, and I'm not taking any cheap shots here because it was freely admitted during the conference I was at, the attendees' age distribution is beginning to look like an inverted pyramid. It's very important for new people to start coming to these conferences to prepare to take the reins at some point down the road. I feel it is very important to begin attending these functions as early as possible because that'll be the best way to root oneself in the field. Additionally, the young, vibrant, and energized (not saying that those with a few more years can't be this way, too) portion of the zoo community often brings new ideas to the table that could very well be useful to the community now.

Another great benefit from these conferences is establishing contacts and networking, which can positively influence your career down the road. You very quickly pick up on everyone's specialties, which can inspire you to ask him or her questions. Listening to these people present (who are no different than me or you) is very inspiring. It is wonderful to be able to talk with them later on during lunch or dinner about their presentation. This leads to the swapping of email addresses so you can further follow-up on said questions down the road. Perhaps when it comes time to look into furthering your career elsewhere, these contacts become a big influence on your decisions and on which zoos you may be interested in. And in the end, the process of determining your new job can be heavily influenced by whom you may know and can make the entire application and interview process much easier. Also, being involved in AAZK and AZA can have wonderful effects on your résumé. Someone who attends conferences is obviously very passionate about their career and is also receiving much of the latest and best information in the field.

During one segment of a seminar, questions were brought up about what the TAGs can do to encourage more keepers to attend conferences and contribute to the community. Everyone feels it is extremely important to draw the keepers to these meetings. I hope to have encouraged some of you to look into attending the next AZA Mid-Year conference in Palm Springs, CA. I will certainly be doing everything in my power to make it there for the week. Your involvement would be deeply appreciated by all in the community and I can guarantee not only will you learn many new things, but also thoroughly enjoy your week.



# Candid Camera:

## Using Camera Traps to Monitor Animal Behavior

By Becky Richendollar, Watani Grasslands Keeper  
North Carolina Zoo, Asheboro, NC

Keepers often wonder what their animals do when no one is watching. Thanks to technology, keepers at the North Carolina Zoo are now getting the chance to find out.

On the Watani Grasslands exhibit, encompassing nearly 40 acres, we house 1.5 southern white rhinos (*Ceratotherium simum*) as well as Nile lechwe (*Kobus megaceros*), Bongo (*Tragelaphus euryceros*), common waterbuck (*Kobus ellipsiprymnus ellipsiprymnus*), sitatunga (*Tragelaphus spekeii*), greater kudu (*Tragelaphus strepsiceros*), Thomson's gazelle (*Gazella thomsoni*), fringe-eared oryx (*Oryx beisa callotis*), blesbok (*Damaliscus dorcas phillipsi*), ostrich (*Struthio camelus*), and Spur-Winged Geese (*Plectropterus gambensis*). While we have strong training programs involving some species, other more skittish species don't allow us to approach. We spend time observing the animals both from our truck on the exhibit and "hidden" with the rest of the people on the visitor overlooks. This has given us some information about the animals' lives. However, we were interested in knowing how the animals behave without any staff or visitors present.

A member of our team suggested using camera traps on our exhibit. Our vet department obtained the equipment that we needed with funds from our "Shadow a Vet" program. We decided that we wanted two cameras and chose to get one with a video option and one without. We chose the Reconyx HC600 HyperFire High Output camera and for our video camera, we purchased the Leaf River IR-7SS. These were picked based on our team member's experience with camera traps. The cameras are triggered by motion, which is useful for busy keepers who don't have time to wade through hours of footage. Images and video are taken only when the animal is in motion, allowing keepers to view 24 hours' worth of images within a few minutes.



An example of how we will be able to track body condition in our Kudu



Early stages of udder development in our pregnant Nile lechwe.

Once the cameras arrived we installed them in our exhibit. From the beginning, we have been rewarded with surprising and useful information. The pictures provided clear images both during the day and at night.

We feed our antelope at three "termite mound" structures that were fabricated by our design department. The termite mounds are designed to draw the antelope closer to the visitors and prevent

our rhinos from eating the antelope grain. The first night we placed our cameras on trees near two of the termite mounds.

Watching the images the next morning, we saw animals eating throughout the evening and night. The greater kudu herd arrived to eat at 0200hrs and came back at 0630hrs. The camera trap captured images of the bongo – animals we have never seen on the north side of our exhibit - eating out of the termite mound near the north end. And throughout the night our antelope shared their grain with a train of raccoons and opossums. We also discovered that in spite of their intended design, the rhinos can and do eat antelope grain at the termite mounds.

We have since moved the cameras to various spots in our exhibit and our holding barn. We have continued to learn new things although we have only owned the cameras for a few weeks. We were able to confirm evidence of a pregnancy in one of our Nile lechwe after she stopped directly in front of the camera, lifted her back leg to scratch her ear and showed us a perfect view of her udder development. We would not have been able to view her udder so closely without the camera. Two weeks later a female calf was born, and we were better prepared for it.



Our bongo eating at night in a spot that we've never seen them eat in before

We also used one of our camera traps to discover that a blesbok in our holding barn was engaging in stereotypical pacing throughout most of the day. Upon seeing the extreme footage we moved him to a larger paddock area and the camera trap documented that he was no longer pacing. The clarity of the images taken by the camera trap and the date stamp feature also will make it easy to track body condition over the long term.

While the camera traps have already proven useful, we see several possibilities for the future, including enrichment evaluation. However, we are most excited for a larger study. Within the next few months



Our three-day old Fringe Eared Oryx calf was observed on the camera trap nursing around 0430hrs. Due to an extremely flighty mother, we had been unable to confirm nursing until we captured it on the camera.

we plan to break our 38-acre exhibit into zones so that we can systematically use the cameras throughout the exhibit. This will help us get an overall picture of exhibit use as well as activity budgets for species and individuals.

While it can be difficult to obtain funds for equipment, camera traps are a useful tool that can improve animal welfare, husbandry techniques, enrichment programs, feeding strategies, and a variety of other aspects of zookeeping.

### Acknowledgements

Special thanks to Dr. Ryan Devoe for providing our equipment and the African Plains team, especially Tamara Norton for her camera trap expertise.



# Porcine Perfection:

## Red River Hogs in Mixed-Species Exhibits

By Lindsey Kirkman, Animal Keeper III  
Disney's Animal Kingdom Lodge, Lake Buena Vista, FL

### Introduction

Are you looking to add variety and interest to your hoofstock or bird exhibits? Or maybe you are short on exhibit space and would benefit from pairing several species together? You might have to look no further than the very versatile red river hog (*Potamochoerus porcus*). This article's intention is to give an unbiased account of Disney's Animal Kingdom Lodge's seven-year history of managing red river hogs in mixed-species exhibits. Hopefully this will give you an idea of whether adding a few active and eye-catching red river hogs to your collection, or moving your existing red river hogs into a mixed species exhibit, may be right for your zoo.

### Mixed-Species History

Since 2004, Disney's Animal Kingdom Lodge has kept red river hogs in some form of mixed-species exhibit ranging in size from six to 12 acres. To date, we have displayed red river hogs with 14 other species of African hoofstock and 12 species of African birds. We typically introduce red river hogs to new species by using a mixing yard to howdy the hogs to the species on the savanna exhibit. A howdy allows the species to see, smell, and interact with each other through some barrier—often a chain-link fence—without being able to make full contact with each other. For some introductions, howdies are not used and species are introduced to each other on exhibit, with keepers watching and waiting to run interference in case of inter-species aggression. With a few exceptions, the hogs are left on exhibit with the other species an average of 20 hours a day and are taken off exhibit only for feeding. The following tables show the species and corresponding sexes that have cohabitated with red river hogs at some point in the Lodge's history (See Fig. 1, Fig. 2).

Species Name	Male	Female
Ankole/Watusi cow ( <i>Bos taurus taurus ankole</i> )	+	+
Bongo ( <i>Tragelaphus euryceros isaaci</i> )	+	-
Bontebok ( <i>Damaliscus pygargus pygargus</i> )	+	+
Grant's gazelle ( <i>Gazella granti</i> )	+	+
Grant's zebra ( <i>Equus burchellii</i> )	-	+
Greater kudu ( <i>Tragelaphus strepsiceros</i> )	+	-
Impala ( <i>Aepyceros melampus</i> )	+	+
Nyala ( <i>Tragelaphus angasi</i> )	+	+
Okapi ( <i>Okapia johnstoni</i> )	+	+
Patterson's eland ( <i>Taurotragus oryx pattersonianus</i> )	+	-
Reticulated giraffe ( <i>Giraffa camelopardalis reticulata</i> )	+	+
Roan antelope ( <i>Hippotragus equinus langheldi</i> )	+	-
Thomson's gazelle ( <i>Eudorcus thomsoni</i> )	+	+
Waterbuck ( <i>Kobus ellipsiprymnus</i> )	+	+

Figure 1. African ungulate species displayed in mixed-species exhibits with red river hogs at DAK Lodge.

Species Name	Male	Female
Abyssinian ground hornbill ( <i>Bucorvus abyssinicus</i> )	+	+
Blue crane/Stanley crane ( <i>Anthropoides paradisea</i> )	+	+
East African crowned crane ( <i>Balearica regulorum gibbericeps</i> )	+	-
Egyptian goose ( <i>Alopochen aegyptiacus</i> )	+	-
Helmeted guineafowl ( <i>Numida meleagris</i> )	+	-
Marabou stork ( <i>Leptoptilos crumeniferus</i> )	+	+
Ostrich ( <i>Struthio camelus</i> )	-	+
Pink-backed pelican ( <i>Pelecanus rufescens</i> )	+	+
Ruppell's griffon vulture ( <i>Gyps rueppellii</i> )	+	+
Spur-winged goose ( <i>Plectropterus gambensis</i> )	+	+
Vulturine guineafowl ( <i>Acryllium vulturinum</i> )	+	-
Wattled crane ( <i>Bugeranus carunculatus</i> )	-	+

Figure 2. African bird species displayed in mixed-species exhibits with red river hogs at DAK Lodge (For both charts a plus (+) indicates hogs have been introduced to the sex of that species. A minus (-) indicates they have never been introduced to the sex of that species

## Group Size

The Lodge's red river hog group size has varied considerably throughout the years, ranging from a single male hog in an 11-acre exhibit, to a family group of 10 hogs: one breeder male, two breeder females, and seven piglets on 12 acres. Currently, we have two mixed-species exhibits containing red river hogs. One group consists of a vasectomized male with two females in a six-acre exhibit. The male is separated for feeding and reintroduced to the females for full-time cohabitation inside



Red river hogs on exhibit with Abyssinian ground hornbills, blue cranes, nyala and impala.

(Photo: Lindsey Kirkman)

and outside of holding. These pigs live full-time with three bird species and six hoofstock species, including okapi. The savanna also houses several breeding groups including nyala, Thomson's gazelles, and impala. This red river hog group has been successfully introduced to nyala calves as young as two months old. Red river hogs have also lived with nesting birds—blue cranes and Ruppell's griffon vultures, to date—with no problems of hogs displacing birds from the nest or trying to steal eggs.

Until recently our second exhibit contained a bachelor group of 3.0 hogs. The hogs coexisted well until approximately age three years. At this time the males began exhibiting aggression toward each other, injuring each other with bites to the testicles

and other areas. These males were separated and reintroduced in different combinations, but each introduction eventually resulted in further aggression. The hogs became difficult to shift in holding, as they were lashing out at each other through fencing and guillotine doors. Hormone therapy has recently begun, the results of which remain to be determined.

## Inter-species Interactions of Interest

Although we have encountered several inter-species interactions in the past seven years, none have resulted in the serious injury of a red river hog. Even hogs that obviously invaded the "personal space" of a giraffe or ankole cow and received a kick or a swipe from a horn amazingly remained uninjured. More often, we have observed positive interactions of a curious nature: hogs following okapi, giraffe following hogs, and even an ankole cow licking hogs. Most cases of observed inter-species aggression have been directly linked to competition for food enrichment such as produce, so we are careful to only place produce where the pigs are not in direct competition with other species. Red river hogs are not shy and will not back down, especially when something delicious is at stake!

## Training

Red river hog training at Disney's Animal Kingdom Lodge fits into three general categories: shift and station training, training for medical purposes, and training for the purpose of enriching the animal's environment. Positive reinforcement combined with a target and a clicker allows us to establish most behaviors. Training for enrichment purposes primarily consists of the trainer "capturing" natural behaviors, such as ripping up a plant or flipping a bowl, and asking the pig to perform it on a cue for a produce reward. The purpose of this training is to stimulate the hogs and establish a rapport between the hog and keeper, all while developing the keeper's training skills. The hogs seem enthusiastic to participate in this interaction with the keepers, learn new behaviors quickly, and are extremely willing to work. The following is a brief synopsis regarding shift/station training and medical training:



Red river hogs investigate a nyala calf.

(Photo: Lindsey Kirkman)



## *Shift and Station Training*

- Hogs are trained to return to holding for a variety of reinforcers (food, puzzle feeders, scents) when they hear their group's specific sound. This is used at least once daily to separate hogs from the other exhibit animals so they may be fed in their holding area. In colder months, this cue is used to bring hogs into holding overnight so they can have a heat source.

- Hogs are also trained to follow a sound and come to a specific area on exhibit when cued. This sound is different from their cue to come into holding. This is useful for calling hogs to an area so guests may view them, or drawing them away from an area where they are unwanted, such as an entrance gate.

- Bicycle horns, bicycle bells, and doorbells have all been used as a cue for shift training.

- Once inside holding, each hog has their own "station." The station is a simple object such as a tennis ball that is hung from the fence. Each hog must stand in front of his specific station to receive a food reward.

This eases hog separating and shifting into separate stalls once inside holding. Hogs are also trained to release from their station and shift on command.



Red river hog station training

(Photo: Lindsey Kirkman)

## *Medical Training*

- Hogs are trained to enter and calmly remain in a crate. This is used regularly for protected contact with our 3.0 group, which are currently being trained for voluntary blood draws.

- Hogs are desensitized to stimuli such as fluids, syringes, needles, and tools for hoof work. They are regularly asked to perform behaviors in front of unfamiliar people.

- Specific behaviors are used to ensure safe and positive contact with the hogs. "Back up" allows us to safely enter the stall without the hog blocking the door. "Lay down" enables us to check the bottom of hooves, check/flush eyes, check teeth and gums, flush wounds, etc., while the hog is voluntarily lying on its side. "Hold" allows us to safely approach while the pig holds position.

- Training has made medical treatment easier for us and reduced stress for the animal as compared to most hoofstock treatment. Using the hogs' tractability and their enthusiasm for training, we have been able to treat most conditions including hoof wear and even an infected vasectomy area without the use of anesthesia.

## **Enrichment**

One of the greatest benefits to adding red river hogs to a hoofstock exhibit is the ability to keep them active and visible throughout the day and evening with some simple, well-timed enrichment. Unlike many other hoofstock species—who are we kidding—most other hoofstock species, the possibilities for enriching red river hogs are seemingly endless, as is their enjoyment of your efforts. In addition, hogs are easily cued to a specific area to facilitate a keeper talk or guest activity or provide visibility where other animals may be lacking. Here is a list of the types of enrichment employed by the Lodge that we feel are loved by the red river hogs:

- Scents: perfumes, spices, and extracts. Perfumes, especially by any famous musician and/or actor/actress, are the hooves-down favorite. These can be sprayed on various exhibit installations, such as rocks and logs, or even plain dirt and grass. To the delight of the guests, the hogs sniff, roll, and rub all their body parts including their hind-end wherever these are used. Completely calorie-free and donations widely available after Christmas.



- **Produce.** Our pigs receive a wide variety of food enrichment, some items daily and some less frequently. Examples include corn, carrots, soybeans, primate biscuits, and watermelon. Pieces are scattered to draw pigs to an area and keep them active or hidden to encourage foraging and exhibit usage. Produce is also thrown into pools so pigs must swim to retrieve it.



A red river hog finding a piece of watermelon enrichment.

(Photo: Lindsey Kirkman)

- Large watering areas such as pools, drinkers, or tubs filled with water.
- Huts, houses, and shade structures.



Red river hogs wading in a pool to cool off.

(Photo: Lindsey Kirkman)



Guests watch from an overlook as red river hogs and nyala forage. (Photo: Vickie Shaw)

- **Puzzle feeders with produce hidden inside.** For added challenge, hang puzzle feeders so that the hogs must jump up and knock produce out, or place feeder in or under a heavy object so that the hog must free the feeder first in order to get it to move.
- **Dirt mounds and mulch piles.** Bury produce or bugs at shallow depths for added interest.
- **Mud wallows.** Add ice during hot weather for continued interest.



Red river hogs rolling and rooting in a mud wallow filled with ice.

(Photo: Lindsey Kirkman)

- **Potted plants.** Our red river hogs love to rip up plants, especially when produce is hidden inside. One favorite recipe:

#### ***Bug-marinated Potted Plants***

- Pull potted plant from container.
- Lightly loosen soil by kicking or with a shovel.
- Replace potted plant in container that has NO holes, such as a plastic bucket.
- Add insects such as mealworms.
- Allow up to an hour for mealworms to burrow into potted plant soil to hide.
- Remove from container and place in the path of a red river hog. Watch guests' amazement as the hogs sniff out the bugs and rip the plant apart to get to them, oftentimes using one of their front feet to help stabilize the root ball.



**Conclusion**

The addition of red river hogs to Disney's Animal Kingdom Lodge's mixed-species exhibits has been a successful and rewarding program. Red river hogs' intelligence, activity level, and unique appearance have endeared them to guests and keepers alike. We receive many guests who come back year after year inquiring after the hogs. Even for guests who aren't initially aware of their presence in the exhibit, seeing the red river hogs running, wallowing, and foraging throughout the savanna produces excitement and an added "bonus" to those who initially were only curious about giraffe and zebra.

Compared to many hoofstock species, red river hogs are easy to house, train, keep active, and keep healthy. The Lodge's red river hogs cohabitate with a large variety of African bird and mammal species, including males and females, calves, and breeding groups. Our hope is that the Lodge's success will inspire other institutions to add red river hogs to their exhibits and even consider other combinations of hoofstock and birds in mixed-species exhibits in order to enhance both zoo animals' and zoo guests' experiences. If you have any questions or would like more specific information, please feel free to contact the author or Steve Metzler, Assistant Curator of Disney's Animal Kingdom Lodge.



Red river hogs running through six-acre Pembe Savanna.  
*(Photo: Lindsey Kirkman)*



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# The Tapir Paper

By Kim Jansen, Hoofstock Keeper  
Nashville Zoo at Grassmere, Nashville, TN

## Introduction

The Nashville Zoo at Grassmere first received 1.1 Baird's tapirs (*Tapirus bairdii*) in 2008. They were housed in an off-exhibit holding area until it was decided to 'feature' the tapirs in a pre-existing exhibit on the other side of the zoo property.

Given more than enough time to acclimate the tapirs to go into a trailer for transport, the keepers began the process with our female, Houston. At this time, Houston was about 10 months into her 13-month pregnancy. Obviously we did not want to wait too much longer to move a very pregnant animal. So we concentrated on Houston's move first.

After Houston was settled into the new barn and gave birth, we waited a month to move our male, Romeo. According to the Tapir Husbandry Manual, the male would need to be separated from the female close to parturition. This gave us plenty of time to train him to go into the trailer.

## 0.1 Houston's Move

Our tapir barn is designed so that the keeper hallway can be used as an animal chute. Even before it was decided that the tapirs were going to move to the new barn, we began working with the female, Houston on moving from stall to stall using the hallway. Using her regular diet as motivation at feeding time, we would set up an adjacent stall with her diet and use her favorite food item to lure her from one stall to the next.

The next step was transporting the trailer to the barn and setting it up for a safe transport. We used a regular horse trailer that was completely open inside (no gates or doors inside). Plywood was used to cover low-lying windows because of tapirs' tendency to climb. To begin with, we allowed the entire trailer to be empty. We discovered that a ramp needed to be built to accommodate the gap between the trailer and the hallway and to aid the tapir in the step upward. We also stuffed hay in the side gaps between the trailer and the barn. Once the trailer was set up safely and the ramp was in place, we were ready to go for trailer training!

Our first training step was to set up the ramp, open the trailer door and place Houston's food dish next to the ramp. We allowed one of the stall doors, which was located right next to the ramp, to be open in case Houston spooked thus allowing her to have a safe 'out'. Houston was a little bit timid about the new set-up in the hallway, but still ate her diet out of the bowl and even placed one foot on the ramp. Soon after finishing her diet, she used that 'out' and went into the stall right next to the ramp.

The second day of trailer training, the keepers placed the bowl on the bottom of the ramp with a portion of it still resting on the barn floor. Once Houston was finished with her diet, she stepped over her bowl and proceeded up the ramp. She stuck her head in the trailer and looked around, but didn't go in. After a few minutes, she backed down the ramp and went into that first stall.

The third day, the food dish was placed at the top of the ramp and a few extra bananas were placed inside of the trailer. Houston went right up the ramp, ate her produce and went into the trailer for the

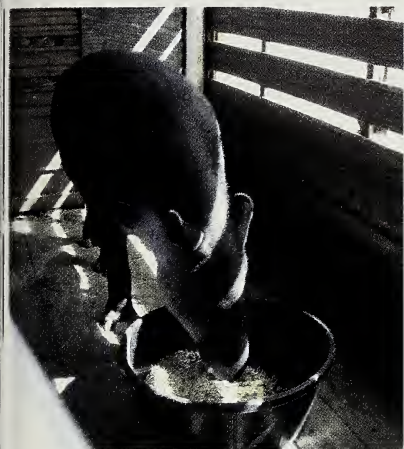


Houston walking down the hallway to the trailer. (Photo: Kim Jansen)



bananas. She stayed in the trailer for a couple of minutes, calmly eating her bananas and then came down the ramp into the first stall.

After this success, we began to regularly feed Houston her diet in the trailer. The only way she would get her diet would be for her to enter into the trailer to eat. We had no problems with Houston acting stressed or agitated while in the trailer. Soon we began to slide the trailer door shut while she was busy eating her diet. Using small steps, we started by rattling the door to get her used to the sound and then eventually worked our way to completely closing the door and securing it with a chain and lock. During this whole process we had fellow zookeepers drive by with their vehicles to get her desensitized to those sounds. Keepers also worked on shaking and moving the trailer to get Houston used to the sensation. Again, Houston showed no signs of stress or agitation. The only time she did become a little uneasy was when a few extra keepers were just outside of the trailer. She calmed down quickly and didn't have any other issues with the number of keepers in the area.



Houston enjoying her diet inside the trailer. (Photo: Kim Jansen)

About a month into the training, we added hay bales to the front of the trailer (Houston was entering from the back). We realized we needed to cut down on the area she would have access to during the actual transport. She needed just enough room to comfortably turn around. We also needed to make sure she couldn't climb any of the bales

and possibly flip backwards. The next training session, Houston went directly into the trailer and ate her diet as if nothing had changed.

Also during this time, we gradually increased the time Houston was spending in the trailer. We started off by holding Houston in the trailer for just a couple minutes after she had finished eating her diet. Eventually, Houston was spending close to 20 minutes of total time in the trailer.

Soon came moving day! The finishing touches were made on the trailer and we were ready. A truck was hooked up to the trailer before Houston was given access to the trailer. We set up the trailer and proceeded with Houston as normal. She shifted into the trailer and we secured her into the trailer like any other day. During the drive, it didn't appear that Houston showed any signs of stress. Once the trailer was set up at the new barn, Houston exited the trailer within a few minutes and began to explore her new holding. We had a successful move in delivering Houston safely and securely to her new barn.

The total time we trained Houston to move into the trailer was less than a month. Her first access to the trailer was 24 February and she was moved on 19 March. Houston really could have been moved a couple weeks before, but we wanted to give her enough time and not rush the process.

### 1.0 Romeo's Move

We realized pretty quickly that moving Romeo was going to be more difficult. There were several reasons we felt this way. For example, Romeo appeared nervous in the barn and any loud noises would spook him. We could not get him to even step a foot in the hallway for shifting. Also, while Romeo liked bananas too, he just was not as food motivated as our female. We decided because of these major differences, the trailer would be moved into his holding yard and he could have access to it 24/7.

So starting at the end of March, we began trailer-training Romeo. We placed his diet bowl on the bottom of the ramp while the keepers were there. Romeo ate out of the bowl without any problem. The bowl was moved halfway up the ramp for the remainder of the day. The next day it was discovered that Romeo pulled his bowl off of the ramp overnight. From that moment on, we offered his diet only in the trailer. Just like Houston, Romeo would have to go into the trailer to get his diet.

Romeo's food dish was placed entirely in the trailer and keepers used a trail of bananas leading up to the trailer. Romeo ate the bananas off the side of the ramp, but never stepped on the ramp himself. Keepers used bananas later that day to lure him on the ramp, but Romeo only got three feet on the ramp. Also, we discovered that Romeo would reach as far as he could into the trailer to get his bananas or to pull his food dish out, but he would never completely enter. Keepers had to eventually screw Romeo's food dish to the bottom of the trailer so he wouldn't drag it out and 'cheat' to get to his diet.

Over the next few days, when we cleaned Romeo's area, he would not go into the trailer to get his diet while keepers were in the area. It was only discovered Romeo had gone into the trailer because all the produce was gone the next day.

Keepers also worked on building a trust relationship with Romeo at the same time by scratching him using a pool deck brush until he would lie on his side. This is one of Romeo's favorite behaviors and we used this to our advantage. We only scratched him in the trailer as a 'reward' for going inside. We continued to work with Romeo over the next month using this technique.

The trailer had to be used in another animal move in the beginning of May and was returned a month later at the beginning of June. Because of this, we did experience a little bit of regression with the trailer training, which we had expected. Once we were able to set the trailer up again, Romeo would enter the trailer when the keepers walked away from the trailer, but not when the keepers were there. Within a week, Romeo would walk into the trailer and stay in there while keepers were present. Again, we used the pool brush as a reward only when Romeo was in the trailer.

At the end of June, we started to shake the chains, holding the door open to desensitize him to the noise. After a few days, keepers began to close the trailer door and hold it shut for short periods of time to again desensitize him. Romeo did not act stressed when the door was shut, he would only turn around and face the door. At the beginning of July, we moved Romeo to the new tapir barn. Romeo shifted into the trailer as normal and the move went smoothly and with very little stress to both the animal and the keepers.

## **Conclusion**

As every keeper knows, each of their animals is different. What works for one animal might not work for another, even though they are the same species. This pertains to multiple things such as what exactly motivates them to train, the speed at which they move through the training steps, or any other part of the training process.

We were able to discover Houston's motivation factor pretty quickly. Houston will do ANYTHING for bananas. She will follow you anywhere for them. In fact, we use bananas to ultrasound her. We were able to use Houston's regular diet, so we did not have to worry about putting extra weight on her throughout the whole training process.

On the other hand, bananas did not work as well for Romeo. His regular produce diet was not motivating enough to get him to go into the trailer as quickly as Houston. He was more nervous about his surroundings and what exactly the keepers were doing. However, once we took the time to develop a training relationship with him, we soon discovered he loved to be scratched and we used that to our advantage.

As with every interaction with our animals, we came away from this whole training experience knowing our animals much better. This helps us become better keepers and often helps anticipate future behavior of our animals. We were also fortunate enough that this whole process was not rushed and could be planned out ahead of time.

## **Acknowledgments**

I would like to thank my fellow co-workers Eric Reinsch, Kyle Chippy, and Michelle Chatterton, who were great throughout this process. Also thanks to our great managers, Karen Rice, Mammal Curator and Connie Philipp, Director of Animal Collections.

*(Note: This paper will be presented in poster form at the AAZK Conference in San Diego, CA in August 2011.)*



**Be a Hirola Hero.** With fewer than 500 left, the hirola is about as close to extinction as it comes. As the only surviving member of its genus, the hirola's loss would represent the first mammalian genus to go extinct on mainland Africa in modern human history.

**Help prevent the loss of an entire genus.** The hirola is the last remaining part of an evolutionary lineage that originated over three million years ago. Those that remain live along the Kenya-Somalia border in an area occupied by the Pokomo community and Ishaqbini Conservancy.

The Nature Conservancy's partner in northern Kenya, Northern Rangelands Trust (NRT), established the Ishaqbini Conservancy to save the hirola in 2006. Residents consider the hirola a blessing and voluntarily set aside a dedicated area for the benefit of hirola and other wildlife.

But the number of hirola continues to decline and with traditional conservation measures proving inadequate, The Nature Conservancy, NRT and its partners created a plan to improve hirola protection, while also benefiting the communities that share their habitat. The effort involves:

- creating a community-run sanctuary;
- providing anti-poaching security;
- protecting habitat; and
- creating eco-tourism opportunities.

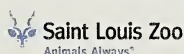
These combined efforts will allow for a sustainable recovery effort and ongoing hirola monitoring and management.



*Hirola on Ishaqbini. © TNC*

**You can help save the hirola by acting today.** Your support will go directly to building and maintaining a "predator-proof" sanctuary. And thanks to a passionate individual who has created a 1:1 matching fund, you can **DOUBLE** your support by donating \$100 or more (maximum of \$10,000). **For more information please email [kmullen@tnc.org](mailto:kmullen@tnc.org).**

*Our Hirola Heroes include the St. Louis Zoo and several private individuals who have already pledged their generous support to this important effort. Thank you!*



**Project partners:**



# Striving for Sustainability: The Ungulate Manager's Toolbox

*By Bill Houston, Assistant General Curator, Saint Louis Zoo; David Powell, Assistant Curator of Mammals, Bronx Zoo; Brent Huffman, Keeper III, Toronto Zoo; and Martha Fischer, Chair, AZA Antelope and Giraffe TAG, Saint Louis Zoo*

SUSTAINABILITY is our new mantra in the zoo world and much has been written about how to achieve it for our animal populations. Without too much thought each of us can probably come up with a list of species that were once found in our collections but no longer exist in zoos today. This phenomenon is not just limited to species that have always been historically rare in zoo collections; the boom-and-bust cycle of species popularity further contributes to the problem. If you have been working in the zoo field for 15 years or more, you can easily point to ungulate species that were quite common in zoo collections when you first started your career, but are now difficult (if not impossible) to find within AZA today. Sadly, some of these same species are also now critically endangered.

Our colleagues tasked with managing bird populations have been way out in front of the rest of us on this issue (it pays to have wings!), having raised the alarm over ten years ago about the complex set of challenges impacting sustainability of bird populations in zoos. Look at this list of just some of the challenges the bird folk identified and ask yourself if it doesn't sound familiar:

- a basic lack of husbandry information for some species;
- zoogeographic trends in exhibit design that favor species from some regions at the expense of species from other regions;
- changing wildlife importation laws impacting the availability of new species and new founders for species already in collections;
- inadequate planning of holding space during exhibit design to handle the growth in population that must occur if we are to ever reach viable population sizes for target species;
- finding a balance between the ideal of self-sustaining populations within AZA facilities and the reality that meaningful partnerships with non-AZA facilities and the private sector will be necessary if some species are to be maintained; and
- recognizing the dynamic tension that sometimes exists between what makes a good exhibit space vs. what makes a good space for breeding of a species.

What is striking about this list is how closely it matches the challenges those of us caring for ungulate species face, and the role it suggests that ungulate keepers can play to help their zoos contribute to the sustainability of ungulate species within AZA:

- **We don't know everything we'd like to know about how best to manage some species.** Ungulate keepers have always been in the unique position to observe and report on how the species in their care are fairing (who sees our animals more than those who care for them day to day?). Those observations are vital to the improvements in management techniques that continue to evolve.
- **Ungulate species require large spaces that are desirable when new exhibit ideas are generated by master-planning processes at our zoos.** Of GREAT concern to the Ungulate TAGs is the downward trend in spaces available for ungulates. A review of the space surveys that the Ungulate TAGs have done over the last decade reveals a net loss of over 1000 spaces for ungulates. Ungulate keepers can help reverse this trend by becoming advocates for these species in both words and actions. The most dynamic ungulate exhibits have dynamic keepers caring for them. Keepers who can see their exhibits through the eyes of the zoo visitors; develop unique and varied enrichment methods that stimulate activity and highlight the natural behaviors of their animals; speak to the public with passion and professional expertise about the importance of ungulates at every opportunity; and maintain an open and constructive dialogue with their zoo's management team help to maintain space for ungulates.



- **The ever-popular savanna exhibit, beautiful and educational as it can be, imposes severe geographic and compatibility limitations on which species can be maintained there.** Not surprisingly, giraffes, which are the primary species of most savannah exhibits, are one of the few ungulate programs that AZA considers truly sustainable. Devoting so much space in AZA zoos to species that a) fit a savanna theme; and b) are compatible with other savanna species drastically reduces the amount of space available for other ungulates that are not savanna animals and/or are not compatible with other species. Under current AZA criteria for judging population sustainability, the Ungulate TAGs will need to look for additional partners that can provide much-needed holding space for many programs, and/or eliminate a number of ungulate program species in favor of devoting more space the remaining chosen few.

Here's a quick fill-in-the-blank quiz:

*Sustainability for our ungulate breeding programs can only be achieved by (fill in the blank).*

Take a minute to think about the obvious. Anyone? That's right!

The correct answer is: breeding ungulates.

"Duh!" you say.

Yet a lack of breeding is the #1 challenge of many ungulate programs. When a new exhibit design strays outside of budget, off-exhibit holding is often one of the first places where costs get cut. That decision impacts programs when the animals in the new exhibit start reproducing. In extreme cases, a zoo can find itself at carrying capacity for a species before they produce their first offspring. It's difficult to be a breeding institution if you lack the space to hold offspring for any appreciable length of time. Fear of negative publicity stops some zoos from considering placement of animals in qualified homes for their progeny outside of AZA. Evidence is mounting that delaying the age of first breeding for too long or limiting reproductive opportunities may inadvertently prevent some females from successfully reproducing at all. It's not a slam-dunk that you can turn their biological clocks back on if you hit the snooze button too many times.

With all of this as backdrop, what's an ungulate keeper to do? We have an obligation to redouble our efforts to overcome these issues. Fortunately, there is much that is in our control which can help us maximize the efficient use of existing ungulate spaces and may even help create additional space for our animal programs.

Sustainability for our ungulates requires a focus on the population as a whole, NOT on the individuals for which we are all caring. If we are to maintain ungulate populations that serve as a hedge against extinction, there will be times when decisions must be made in favor of the population at the expense of the individual. This places a unique burden of responsibility on keepers. Keepers get to know our animals in a way that no one else in the zoo can, and are encouraged to pour their hearts and souls into the care of the individuals for which they are responsible. That creates a bigger emotional investment for keepers to overcome when asked to support population-level decisions that must sometimes take precedence over what a keeper might like to see happen for an individual in their care.

Sustainability can only be achieved by breeding our animals. Breeding inevitably leads to some offspring for which the population as a whole does not have an immediate need. Thus breeding animals requires space, resources, and creativity to ensure that the population can be grown to a sustainable population size and maintained as a healthy, reproductively viable unit.

The Ungulate TAGs look for ways to help our program leaders wring the most out of the available space for the species that they champion. One outcome of recent joint Ungulate TAGs discussions was the realization that there was a need to provide an outline of the many options available for dealing with the inevitable growth in herd size that any successful breeding program will create. While there is no one-size-fits-all solution to help zoos optimize their ungulate space, we hope that what follows

here will spark some further creative thinking about how your zoo can be an even stronger partner in ungulate breeding programs. Here is a breakdown of some of the most commonly-used tools within the ungulate management toolbox:

- |                              |                        |                                    |
|------------------------------|------------------------|------------------------------------|
| *Mixed-Species Herds         | *Management Euthanasia | *Partnerships outside AZA          |
| *Bachelor(ette) Herds        | *Off-Exhibit Holding   | *Collaborative Breeding Centers    |
| *Contraception/Sterilization | *Rotating Animals      | *Alternative Management Strategies |
| *Management of Aggression    |                        |                                    |

**Mixed-Species Herds:** Mixed-species exhibits can substantially increase your ability to support the ungulate programs in which your zoo is involved. Suddenly an exhibit that supports one ungulate program can now support two or more with the right mix of species. As the group most intimately familiar with both the individual personalities and behavioral traits of the animals in their care, keepers can play a big role in helping zoos advance the use of this tool. Think outside the box. Ungulates can be compatible with more than just ungulates. Even non-ungulate species exhibits can provide you with a temporary outlet for those young males you produced last season, or those females you need to rest this year while still continuing to breed the others in their dedicated exhibit. Additional benefits to mixed exhibits include greater visitor interest, a built-in source of enrichment for all the species involved, and an opportunity to display the same species in different ways. Considerations you will want to keep in mind when experimenting with this tool include selection of compatible species, provision of adequate escape routes and visual barriers (particularly during the introduction), and the avoidance of hybridization issues. A great resource to get you started on your brainstorming for antelope in particular can be found at [http://www.antelopetag.com/mixed\\_species\\_survey.htm](http://www.antelopetag.com/mixed_species_survey.htm).

**Bachelor(ette) Herds:** While all of us like to see calves on the ground in every exhibit every year, if a zoo wants to achieve rock star status in one of the AZA breeding programs in which it participates, its Institutional Representative should call the Species Coordinator for the program in question and say these five words:

"We're willing to hold bachelors."

In order to meet both demographic and genetic targets for sustainability, our ungulate programs need to breed, and for many of these species that automatically means we will, at any given time, have more males in the population than are currently needed at that time. Those last three words are emphasized because in every program out there, program leaders have found that at least some of these "extra" males may suddenly rise in genetic priority and be desperately needed as breeders. Unless a program leader is clairvoyant, it is impossible to predict with any great accuracy whether this year's males will be needed for breeding in future years. Genes that are common and well-distributed in the gene pool today can become quite rare and desirable in a very short period of time due to unpredictable events like deaths, reproductive failures, and exports out of the managed population. Every program leader needs more zoos to step up and think creatively about how to hold male offspring longer. Keepers can be great advocates within their zoos for this kind of contribution by being open to experimentation with bachelor herd development and helping to fine-tune protocols specific to their facilities that increase compatibility and stability.

Likewise, those zoos willing to hold bachelorette herds as needed perform an invaluable service to the population as a whole. Not every female will be given a breeding recommendation each year. As a general rule of thumb, breeding institutions should strive to have the capacity to hold any offspring they produce for two years. If a zoo finds itself strapped for space every time a species gives birth, it may wish to give serious consideration to holding bachelor or bachelorette groups instead to help AZA program leaders reach a target population size that is truly sustainable.

Regardless of their sex, most ungulates are social critters that do better if they can have some social interaction with conspecifics. Bachelor/Bachelorette herds provide that much-needed social context and ensure that the population has the deepest possible pool of socially competent animals from which to choose future breeders.



Ungulate programs will benefit greatly if all levels of animal care staff recognize that the contributions of zoos asked to "Hold/Don't Breed" in program masterplans are just as essential as those that are asked to breed their animals. Our capacity for sustaining populations is built by holding onto appropriate numbers of the animals we produce, not just by producing them.

**Contraception/Sterilization:** There have been great strides made over the last 15 years to create safe and reliable methods of contraception for a variety of ungulate species. The AZA's Contraception Advisory Group ([www.stlzoo.org/contraception](http://www.stlzoo.org/contraception)) maintains a large database on various forms of ungulate contraception, and is in the best position to guide zoos in selecting methods that best fit their needs. There is enough experience with some forms of contraception to show that these methods, applied thoughtfully, can be reliably reversible for several ungulate species. Contraception can, under the right circumstances, be a viable alternative to separation of animals and the social disruption such separation can cause. It can also be used to better time the onset of calving season to coincide with the most favorable conditions. However, there can be negative effects of long-term contraception use, so zoos should exercise appropriate care to consult with the AZA Contraception Center on the latest species-specific recommendations. Sterilization, while an appropriate tool under the right set of conditions, should always be looked upon as a last-resort option. Sterilization creates animals that use valuable space and other resources critically needed to support breeding animals and the growth of our populations towards sustainability.

**Management of Aggression:** Primate managers have been exploring this approach over the past 15-20 years. While less commonly applied to ungulates, management of aggression is a field that needs further study. Like contraception, management of aggression may be an alternative to separation of aggressive ungulates and the social disruption this can cause. In a recent seminar conducted at the AZA Regional Meeting in Chattanooga, TN in March of 2011, the broad topic of managing aggression in a variety of diverse taxa was broken out into four broad categories:

- 1) Trials to suppress aggression hormonally;
- 2) The use of behavior modification to reduce aggression;
- 3) Facility design to reduce aggression; and
- 4) The application of medications to better manage aggressive individuals.

The Powerpoint® presentations and synopses of discussions that followed from the above seminar are a good reference for anyone interested in exploring the topic of aggression management further. AZA's Contraception Center has made these available on CD for a nominal fee by contacting Dr. Cheryl Asa via e-mail: [asa@stlzoo.org](mailto:asa@stlzoo.org).

The one caution to remember is that aggression is a natural behavior that serves a useful social function, so its complete suppression is not a realistic or desirable goal.

**Management Euthanasia:** Management euthanasia (the humane euthanasia of an animal for reasons not related to its age or medical condition) is not a tool we should shy away from discussing. The World Association of Zoos and Aquariums, AZA, and the Ungulate TAGs recognize management euthanasia as an acceptable tool for maintaining populations of animals for the long term. Many zoos have management euthanasia available as a tool in their management toolbox, although institutional policies where management euthanasia is allowed vary greatly. If used, this tool needs to be clearly explained to the keeper staff, zoo Public Relations department, and senior leadership to make sure everyone understands its purpose. The choice on when to apply it (to neonates vs. older animals) is one that should also be determined up front. Some institutions find it easier to apply to newborns. Many animal managers in Europe believe that animals should be allowed to breed naturally and experience the fullest range of natural behaviors to promote welfare, including birth, lactation, and rearing. Thus they sometimes prefer a breed-and-cull strategy for offspring post-weaning over using contraception, separation, and bachelor groups to promote welfare and sustainability. This approach may also have the added advantage of developing the most socially competent mothers, a prerequisite to developing a sustainable population.

**Off-Exhibit Holding:** Ask anyone who cares for ungulates to name the greatest limitation to the

growth of their herds and they will all invariably answer S-P-A-C-E. One of the first things to be reduced or removed during exhibit design budget cuts is off-exhibit holding space. This often backfires, because the rate-limiting factor on how many animals can be displayed is more often the amount of off-exhibit holding, rather than the size of the exhibit itself. The display habitats may be able to comfortably house large herds, but the barns to which the animals must be brought at night or during inclement weather hold only a fraction of the number of animals that the habitat can hold. It is interesting to note that AZA's Avian Scientific Advisory Group (ASAG) has recommended that at least 30% of bird-holding space be devoted to off-exhibit holding.

Keepers should strive to maintain a positive and constructive line of communication with their zoo's decision-makers at all times so their voices can be heard. Never underestimate the power of constructive keeper advocacy. While we all need to realize that financial and other limiting factors often mandate compromise, all of us caring for ungulates have an obligation to clearly and rationally communicate both the advantages to additional holding space and the ramifications of making cuts in this area.

The advantages to planning adequate off-exhibit holding into an exhibit are many: it allows a zoo the option to hold the previous year's offspring; good off-exhibit holding areas allow zoos to provide some privacy for dams and their neonates when needed; back-up males for the breeding program can be held; off-exhibit holding can serve the needs of more than one species; and zoos with adequate holding space have additional options to separate animals when breeding is not desired. The one caveat to the tool of off-exhibit holding is that the social needs of ungulates housed there must always be considered carefully. In some cases, other tools in the toolbox might be a better fit (mixed species displays, bachelor(ette) herds, etc.).

**Rotating Animals:** No, we are not talking about the fast-growing trend of zoo carousels here. This tool refers to the use of display habitats and holding space to rotate different animals on and off display, giving everyone a chance to go outside. This tool provides another way to hold onto offspring longer, and house back-up males for your breeding programs. It can also be used to hold females open for a breeding cycle as needed. Depending on the complexity of your rotation, it can also be quite enriching for the animals to move around in different combinations and through multiple displays and holding areas, and to be exposed to different routines. This can provide a significant improvement in the quality of life for animals that might otherwise be confined indoors or in a small back holding area. Rotations can be established to fit a variety of circumstances, ranging from a day/night split of access to a habitat between two groups, to every other day splits, weekly/monthly or even seasonal splits.

**Partnerships Outside of AZA:** The reality is that without looking outside of AZA for some creative solutions, we will not be able to sustain nearly as many ungulate programs as currently exist in AZA. Green SSPs®, defined as programs that can meet AZA's sustainability benchmarks using only those animals held within AZA institutions, are extremely rare. Only two ungulate SSPs are currently considered sustainable – giraffes and Grevy's zebra. The majority of our programs are either Yellow SSPs® or Red programs. For more detail on AZA's new color-coding of breeding programs based on their sustainability, visit <http://www.aza.org/Membership/detail.aspx?id=16616>

Fortunately, AZA recognizes that in order for Yellow and Red programs to attain sustainability, program leaders will need to explore options that include partnerships with non-AZA member institutions. We need to break down some of the barriers that have evolved between AZA and non-AZA institutions, and start looking for those areas where we can cooperate productively, rather than focusing so intently on our differences. If we are to move Yellow and Red programs closer to sustainability, each of our zoos will need to evaluate current institutional policy with regard to non-AZA institutions and determine under what circumstances we are willing to partner outside of AZA. If we are honest about it, from an animal welfare perspective, there will likely be times when sending animals we do not have the capacity in AZA to hold at this time may well be the best tool to apply from among those listed above, particularly if we form strong partnerships with such institutions that allow us to freely exchange and retrieve animals as needed for the program. Partnerships with facilities outside of the AZA also give us the opportunity to learn and experiment with different housing designs and management strategies.



**Collaborative Breeding Centers:** In recent years there has been much discussion about forming collaborative breeding centers. Perhaps the best known example of this is the fledgling organization known as Conservation Centers for Species Survival, or C2S2 for short. This group of large acreage AZA facilities is dedicated to cooperative management and research for the advancement of species conservation. C2S2's goal is to apply the unique and collective resources of its member institutions to the survival of species with special needs, especially those requiring large living areas, natural group sizes, minimal public disturbance and scientific research. Clearly ungulates are perfect candidates for such facilities. Founding institutions for C2S2 include Smithsonian Conservation Biology Institute, Fossil Rim Wildlife Center, White Oak Conservation Center, The Wilds, and San Diego Zoo's Safari Park. For more information on C2S2, visit <http://www.conservationcenters.org/what-is-c2s2/>.

**Alternative Management Strategies:** The traditional method by which we manage most SSP® programs has involved mating strategies in which we select each breeding pair based on specific demographic and genetic criteria as recorded in our SSP management dataset. This system has worked extremely well over the years for a variety of taxa, particularly those for which we have highly accurate and reliable pedigree information. This method, however, is only as good as the data used to build the management dataset. For many species in our care, significant assumptions are built into our datasets out of necessity to "fill in the blanks" as best as possible where pedigree information is poorly known or non-existent altogether. There is a growing interest in exploring alternative management strategies for such species. One alternative under discussion involves mate selection studies. The aim is to gain a better understanding of how a species, left to its own devices, selects a mate. There have been some intriguing studies done recently that suggest some species, through mechanisms we don't yet fully understand, have the ability to select mates that are more distantly related if given a choice.

Even if the above does not turn out to be the case for most ungulate species, there may be other compelling reasons related to social development and reproductive competence that make alternatives like mixed sex herds (containing multiple males and females and multiple age classes) an attractive alternative to the more stringent pair selection we have been following. What we lose in definitive knowledge about individual pedigrees over time may be more than offset by the development of a more robust, genetically diverse and socially competent population as a whole.

**THE TAKE-HOME MESSAGE** from all of this is that our focus needs to be on the population as a whole, rather than on the individuals in that population. Sustainability can only be achieved by breeding our ungulate populations, and that breeding will always challenge our capacity to deal with the inevitable population growth. We must think creatively about how we can grow our capacity to hold more ungulates. Fortunately, there are a large number of tools we can use to increase our carrying capacity for ungulates and so enhance their sustainability. When selecting the appropriate tools for use with a particular species, it is important to factor in the social needs of these ungulates. Herd animals do best when managed in herds. All of the tools we've described above can help us manage ungulate populations for long-term sustainability, but they also challenge us to be better managers and expand our own skills and knowledge base.

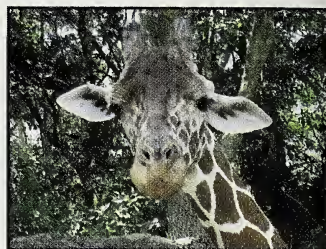
The Ungulate TAGs are a great resource to help institutions evaluate options for managing their ungulate collections. Within the framework of proper procedure and chain of command within each zoo, we encourage everyone to pick up the phone, fire off an e-mail, text, tweet or otherwise call upon the Ungulate TAGs for assistance. If you feel the need for additional training in ungulate care, ask your zoo about the possibility of signing you up for one of the newly-launched Ungulate Care Workshops. AZA Animal Care Manuals, in various stages of development by the Ungulate TAGs, will provide you with comprehensive reference material on all aspects of ungulate management. Sustainability is the responsibility of everyone in the zoo industry. If you have developed additional ungulate management tools, be sure to share them with your peers – in articles, presentations, or posters – so that we can all benefit from your experience.

# Managing a Reticulated Giraffe (*Giraffe camelopardalis*) with Allergies

By Melaina Kincaid-Wallace, Keeper I and Kristen Wolfe, Zoological Manager  
Disney's Animal Kingdom, Lake Buena Vista, FL

## Introduction

Thika, a 21-year-old female reticulated giraffe (*Giraffe camelopardalis*), at Disney's Animal Kingdom in Lake Buena Vista, FL has presented multiple allergy symptoms since August 2000. She was born at the Calgary Zoo in 1989 and lived at the Indianapolis Zoo from October 1991 to December 1997 before being transferred to Animal Kingdom. Prior to her arrival at Animal Kingdom she had a history of lameness due to a broken P3 bone, abomasal endoparasitism, and rumen acidosis, but no symptoms of allergies.



Thika - 0.1 reticulated giraffe

While at Disney's Animal Kingdom she has been housed both at the Animal Kingdom Lodge and Animal Kingdom Park. The giraffe herds have varied in size, from two to 12 giraffes, and age with infants to full grown breeding males and females. She has also shared the savannah exhibits with a variety of ungulates and birds. The savannahs are made up of a diversity of plant life including native and exotic trees, shrubs, and grasses.

## Symptoms and Treatment

Thika's initial allergy symptoms included head shaking, ear shaking, and a foul odor, discharge and drooping from both ears. These symptoms occurred seasonally, each summer, for five consecutive years. The following two years keepers noticed that her ear infections were occurring in the summer and fall and were lasting longer each time. Her blood work was also changing, higher culture counts



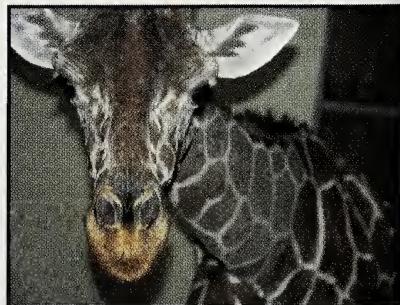
Giraffe in the chute with vet staff

were obtained and the infections were yeast rather than bacterial. Thika also became less cooperative with treatments and occasionally required sedation to accomplish the treatments. Throughout this time the staff veterinarians would take cultures of her ears and draw blood to check for infection. She was receiving ear flushes and antibiotics when infections would set in.

In 2009 there was a shift in her symptoms. Thika began scratching her abdomen, chest, neck and head. She experienced hair loss, mainly in the neck region, and developed sores. Oral antihistamines and hydro-plus flushes were prescribed along with a Nolvasan® flush and a vinegar/water flush for her ears. Nutritionally

flax seed oil was added to her diet to help with her dry skin. Staff also altered her holding and feeding set up. Rectangular hay containers were replaced with round hay barrels to avoid edges and hung above scratching level. Grain containers were also raised. New scratching devices were placed in Thika's stall that were less abrasive (soft deck brushes, etc). Thika was held off of the savannah for a period of time as well in order to isolate her from gunite walls on which she had begun scratching.

Pain medications and antibiotics were prescribed due to continued infection and swelling in the ears. Antihistamines were increased and altered in an attempt to find a dose and type that would be most effective. Staff was unsure as to why there had been a shift in symptoms



The white area is the hair loss induced by excessive scratching.



and why the symptoms were so persistent. Allergies to insect bites were a possibility so fly spray was applied, but was found to be ineffective. Veterinarians decided to take punch biopsies from the right side of her body where the skin was most affected, however there were no significant results.



Hives that developed during a period of excessive scratching

A regimen of baths was prescribed. The regimen began with Nolvasan® baths which were applied and scrubbed into the skin using a deck brush. The diluted Nolvasan® would then set for five minutes before being thoroughly rinsed off. The Nolvasan® baths were completed once a day for four days at which time they were discontinued because Thika developed hives on her abdomen presumably from the baths. The next round of baths was a DermaPet DermAllay™ oatmeal shampoo. The shampoo was applied, scrubbed into the skin, and allowed to set for five minutes before being rinsed off. A Derma Soothe™ anti-itch cream rinse was then applied and left on for the day. The DermaPet DermAllay™ baths were given daily for five days then every other day for another

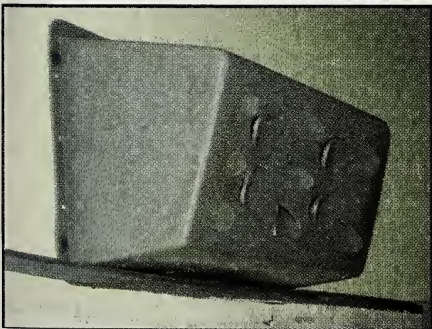
12 days. The final round of baths was Universal Medicated shampoo. They were applied, scrubbed in, and allowed to set for ten minutes before being rinsed off. The baths were given every other day for two weeks before being discontinued. During this regimen Thika showed no improvement and continued to have dry and flaky skin.

In conjunction with the baths Thika was also receiving antihistamines and her diet was changed from a mix of Mazuri® Wild Herbivore and Mazuri Plus grain to 100% Mazuri® Plus. The diet change was mainly due to Thika's loss of weight at this time. External Wind™ nutritional supplement was prescribed for 30 days twice a day, but was discontinued after a week due to Thika's refusal to consume it.

Following the regimen of baths, a steroid injection was given along with antibiotics, Uniprim™ for the skin infection, was prescribed once daily for two weeks at which time it was extended for another two weeks. Upon a veterinary check-up the prescription was extended for an additional two weeks, so in total she received the Uniprim for six weeks. Her flax seed oil supplements were also increased and fish oil supplements were added into her diet. Bloodwork had shown Thika to be anemic so a red cell supplement was added into her diet as well. Keepers noted the most significant improvement following the steroid injection. Her wounds began healing and scratching decreased. The steroid seemed effective for approximately a month at which time Thika would once again begin scratching and her skin would become flaky. An additional steroid injection was given two months prior to her allergy testing. (In order to obtain the most accurate results steroids could not be given close to the allergy testing.) A list of medications, baths, and supplements can be found in Table 1.



Sores caused by excessive scratching



A scratching board that was created to provide relief without sharp edges that would cause injury.

### Allergy Testing and Results

In December of 2009 a local veterinary dermatologist was consulted on Thika's case. She recommended skin-based testing for allergies based on equine protocols. The equine test includes 50 injections to test Thika's reaction to several types of hay, grain, and Florida plants as well as a control. The test requires the skin to be shaved and each injection administered in a marked location. We were able to administer all of the injections during one training chute session.



Ten minutes after the injections were given they were evaluated by the veterinarian for histology response in comparison to the control. See Table 2 for the results.



Allergist marking the potential test sites



Allergist administering the individual injections at each site



Allergist evaluating the reaction to each injection 15 minutes after being administered

Based on the results of the testing, an allergy serum was designed specific for Thika. On 15 January 2010 Thika received her first allergy injection from the veterinarian on staff. An 18-gauge needle was used and injected 0.1 ml of serum subcutaneously into one of the skin folds on her side. Allergy injections can have adverse side effects such as regurgitation, diarrhea, hives, ataxia, labored breathing and the animal collapsing. After each treatment was administered Thika was held in the barn or yard for two hours before being shifted onto exhibit to watch for any of these symptoms.

Allergy injections require a "loading period" for the serum to stimulate antibody production in the patient. During this phase the antibody concentration in each vial of serum also increased. Thika's first vial would be used for four injections, increasing from 0.1 ml to 0.8 ml. The same course of treatment was used with the second vial. During this 21-day period no significant change was noted in Thika's behavior. It was noted that she was not scratching as much, but we had seen this pattern before at this time of year.

During this "loading phase" her normal behavioral training routine was modified. A typical training session in the chute was usually based on Thika's willingness to participate. As with all training sessions some days were better than others. The minimum training criteria was to have three feet in the chute and her maximum was to close her in the chute and perform maintenance behaviors (tactile, targeting, etc). We found on days following Thika being closed in the chute she would have major setbacks and not clear the chute for weeks. This was not conducive behavior for regular injections. It was determined on injection days she would be manually pushed into the chute using a permanent wooden push wall, given her injection and released. In doing this, on non-injection days her training would stay consistent and not regress.

The series of injections continued at three-day intervals for the first month. During the second month they were increased to every 10 days and after three months she was on a maintenance level of every two weeks. Keepers were trained to give the injections during the maintenance phase. During the third month (March), no notations were made in the daily reports of Thika scratching and hair loss had stopped. In April she was observed scratching more frequently in holding and on the exhibit.

Throughout the spring Thika continued on the allergy injections, but increased scratching was still observed. She was maintained on her supplements, though there were periods of decreased consumption. She was started on the antihistamine again to decrease the itching and this continued through the summer. Due to the decreased food consumption more and more creative ways to administer her supplements and medicine were tried. In July Thika started to have decreased urination along with the decrease in food consumption. She had substantial weight loss during this month as well.



TABLE 1

Date	Drug	Purpose	Comments
8/15/06-8/21/06	saline	ear flush	
8/15/06-8/21/06	Animax ointment	antibiotic	
8/31/06-9/20/06	dilute Nolvasan	ear flush	
8/31/06-9/20/06	Animax ointment	antibiotic	
8/3/07-8/8/07	dilute Nolvasan	ear flush	
8/3/07-8/8/07	Animax ointment	antibiotic	
10/31/08	dilute Nolvasan	ear flush	Azaperone sedative required
12/31/08	dilute Nolvasan	ear flush	
1/2/09-1/30/09	dilute Nolvasan	ear flush	
1/2/09-1/30/09	water/vinegar	ear flush	50:50 ratio
4/30/09	water/vinegar	ear flush	50:50 ratio
5/3/09	saline	ear flush	
5/3/09	water/vinegar	ear flush	
5/3/09	Animax ointment	antibiotic	
5/5/09-5/9/09	water/vinegar	ear flush	50:50 ratio;qod
5/8/09-5/16/09	Hydroxyzine	antihistamine	400mg
5/10/09-5/16/09	Hydro-plus	ear flush	burrow's solution with hydrocortisone
5/17/09-5/27/09	Hydroxyzine	anti-histamine	increased to 600mg
5/28/09-6/17/09	Hydroxyzine	anti-histamine	increased to 800mg
6/15/09-6/24/09	Hydro-plus	ear flush	burrow's solution with hydrocortisone
6/18/09	Cetirizine	antihistamine	200mg
7/5/09	water/vinegar	ear flush	50:50 ratio;once a week for 12 weeks
7/13/09	Endure	fly spray	every 5 days for 4 treatments
7/22/09	lime sulfur	bath	punch biopsies taken
8/1/09	dilute Nolvasan	bath	scrub into skin, set for 5 minutes, rinse;caused hives
8/5/09	DermaPet DermAllay oatmeal shampoo/Dermal Soothe anti-itch crème	bath	scrub into skin, set for 5 minutes, rinse;crème left on;fly spray discontinued
8/9/09	External Wind	nutritional supplement	35g BID for 30 days, stopped after 1 week due to lack of consumption
8/10/09-8/21/09	DermaPet DermAllay oatmeal shampoo/Dermal Soothe anti-itch crème	bath	scrub into skin, set for 5 minutes, rinse;crème left on;qod
8/24/09-8/28/09	Universal Medicated shampoo	bath	set for 10 minutes & rinse;qod;extended 2 weeks
9/10/09	Depo-Medrol	steroid	

9/10/09	Uniprim	antibiotic	2 packs SID for 14 days;baths discontinued
9/12/09	Excede	antibiotic	
9/12/09	DermaPet Derm Allay oatmeal shampoo	bath	bath given by vet
9/24/09	Uniprim	antibiotic	extended 14 days
10/19/09	Iron Horse or Finishline red cell	nutritional supplement	30 days
10/23/09	Depo-Medrol	steroid	
1/4/10	Depo-Medrol	steroid	Azaperone sedative required
1/4/10	Tulathromycin	antibiotic	Azaperone sedative required
1/14/10		allergy injection	see table
5/12/10	Cetirizine	anti-histamine	400mg
6/25/2010	Cetirizine	anti-histamine	increased to 600mg
8/24/2010	Iron Horse or Finishline red cell	nutritional supplement	discontinued due to blood results
Note: SID=once a day, BID=twice a day, qod=every other day			

In September fewer bouts of scratching were noted. Since resumption of allergy injections in January no open skin sores or ear infections have been noted. She was taken off the red cell supplement and started on a vitamin E supplement based on new blood work results. Thika had appeared to make it through the allergy season better than in years past. However, in November she relapsed. Violent scratching led to open sores on her abdomen. Her fecal and urine output decreased and she became lethargic. Blood was taken and it was determined that she had a bacterial infection. She was given antibiotics, but the scratching was worsening. She was given Diphehydramine but was unresponsive. Steroids were resumed in mid- November. Blood was taken weekly to monitor her white blood cell count for signs of infection. After the infection cleared the scratching also subsided and she was taken off the antihistamine in January of 2011.

Two weeks after being off the antihistamine Thika started scratching again. After evaluating the last year's treatment and allergy injections, the veterinary staff wanted to try a newer form of allergy testing. They drew blood and a sample was sent off for serum antibody analysis along with banked blood from previous blood draws. It was determined to try the blood analysis and compare the results of the two testing styles. See Table 2 for blood analysis results and comparison to the injection results. Based on those results a new serum was developed for Thika's injections.

## Conclusion

Currently Thika is in the "loading dose stage" of the new allergy serum and is receiving antihistamine tablets once again along with her flax seed oil, fish oil, and vitamin E supplements. Staff continues to carefully observe and record Thika's behaviors, consumption, and weights however it is too soon to determine if the new serum will help to alleviate Thika's symptoms. We continue to monitor Thika's progress and look for new and inventive methods of controlling her allergies.

## Acknowledgements

We would like to thank Disney's Animal Kingdom veterinary staff for their contributions and guidance. We would also like to thank the West Savannah animal care staff and Savannah Zoological Managers: John Strickland, Karen Jasmin, Steve Castillo, and Gary Noble as well as Joe Christman, Area Operations Manager for their support. Last but not least, we would like to thank Dr. Jill Mellen, Education and Science Director for editing this paper.



TABLE 2

Test	Draw Date 7/12/09 (Banked Blood)	Draw Date 1/4/10 (Banked Blood)	Draw Date 7/12/10	Skin Test 12/18/09	Recommended Treatment
Alder Mix	222	169	212		T
Ash Mix	184	168	193		Treated by Privet/Olive
Bayberry	258	214	181		T
Beech American	154	206	170		Treated by Oak Mix
Birch Mix	184	181	218		Treated by Oak Mix
Box Elder					
Box Elder/Maple Mix	247	181	169		Leave out due to number of allergens
Ca. Pepper Tree	149	144	166		
Red Cedar				2	
Bald Cypress (Cedar)				2	
Cedar Mix (Juniper)	128	178	164		T
Cottonwood (Poplar)	155	167	155		
American Elm					
Elm Mix	149	142	180		Leave out due to number of allergens
Eucalyptus	171	218	193		T
Mulberry White	167	149	167		
Live Oak				2	
Oak Mix	164	177	196		T
Pecan Pollen	206	181	181	2	T
White Pine				2	
Pine Mix	141	167	166		T
Pine Australian	176	204	186	2	T
Privet/Olive Mix	284	244	181		T
Queen Palm	164	194	167	3	T
Sycamore Mix	224	197	165		Leave out due to number of allergens
Walnut Black	210	157	160		
Willow Black	134	149	146		
Orange Tree					
Melaleuca				2	BMS does not carry this allergen for treatment
Bahia Grass	159	201	197	3	T
Bermuda Grass	136	148	154		
Bluegrass (Junegrass)	257	250	183		T
Brome Grass	154	200	176		Treated by Bluegrass
Johnson Grass	121	125	124	3	Treated by Bahia Grass
Orchard Grass	149	146	157		
Reed/Sweet Vernal Mix	128	149	156		
Perennial Rye Grass					
Rye/Fescue Mix	136	182	192		Treated by Bluegrass
Timothy Grass	214	200	183	3	Treated by Bluegrass
Red Top Grass					

Alfalfa Pollen	265	194	182		T
Baccharis	149	107	161		
Clover Red	268	189	170		T
Cocklebur	162	125	128		
Daisy	237	258	177		T
Dandelion	149	125	149		
Yellow Dock					
Sheep Sorrel				2	
Dock Mix/Sheep Sorrel	143	170	149		Leave out due to number of allergens
Dog Fennel (Chamomile)	166	132	155		
English Plantain	228	230	208	2	T
Goldenrod	176	163	149		
Lambsquarters	119	120	247		T
Marsh Elder	115	114	100		
Mugwort Common	135	147	147		
Mustard Pollen	193	184	201		T
Nettle	209	215	213	2	T
Pigweed Mix	161	149	158		
Ragweed Mix	137	144	157	2	T
Russian Thistle	108	131	141	3	Treated by Lambsquarters
Alternaria tenui	176	158	205		Leave out due to number of allergens
Aspergillus fumigatus	144	124	308		T
Aspergillus Mix	116	101	106		
Botrytis cinera	166	143	100		
Candida	154	159	176		Leave out due to number of allergens
Cephalosporium	123	120	263		T
Cladosporium	169	148	215		T
Epicoccum	176	176	250		T
Fusarium	146	144	148		
Grass Smut Mix	176	138	125		
Helminthosporium	100	110	113		
Mucor	168	208	243		T
Penicillium Mix	113	101	129		
Pullularia pullulans	196	239	269		T
Rhizopus nigricans	214	202	269		T
Cat Epithelia	168	133	169		
Cockroach Mix	179	158	171		
Flaxseed	126	128	113		
Grain Mill Dust	192	144	187		T
Mouse Epithelia	149	115	100		
Pyrethrum	336	281	162		Advance only
Sheep Epithelia (Wool)	126	134	149		
Acarus siro	111	106	100		
Ant Black	141	126	133		



Ant Fire	200	200	201		T
Blomia/Lepido Mix	178	177	154		
Caddisfly	178	192	226		T
Culicoides 500				2	
Culicoides 1000					
Culicoides	176	149	161		T
Deer Fly	124	112	127		
House Dust 25				3	
House Dust Mite 25					
Dust Mite Mix	201	170	149		T
Hornet Wasp	219	203	279		
Horse Fly	132	117	135		
House Fly	111	106	133		
Mosquito 500					
Mosquito 1000					
Mosquito	100	100	100		
T. putrescentiae	176	184	166		Leave out due to number of allergens
Horn fly 500					
Horn fly 1000					
Stable fly 500					
Stable fly 1000					
Apple	167	149	156		
Barley	207	210	188		Avoid
Beets	157	160	137		
Carrot	120	124	112		
Corn	190	179	168		
Molasses	100	100	100		
Oats	149	154	156		
Rice	218	187	177		Avoid
Soy Beans	206	204	187		Avoid
Wheat	179	185	192		Avoid
Class Score	Test Score				
Negative	<=150	0			
Borderline	151 to 174	1			
Borderline-Positive	175 to 199	2			
Positive	200 to 400	3			
Highly Positive	>400	4			

*Photos for this article by  
West Savannah Animal Keepers  
Disney's Animal Kingdom®*

## Ungulate Websites of Interest

www.ultimateungulate.com	(Ultimate Ungulate)
www.antelopetag.com	(AZA Antelope and Giraffe TAG)
www.saharaconservationfund.org	(Sahara Conservation Fund)
www.giconline.org	(Okapi Conservation Program)
www.nrt-kenya.org	(Northern Rangelands Trust)
www.giraffeconservation.org	(Giraffe Conservation Foundation)
www.giraffecare.org	(International Association of Giraffe Care Professionals)
www.grevyszebratrust.org	(Grevy's Zebra Trust)
www.savethewildhorse.org	(International Takhi Group – Przewalski's Horse)
www.conservationcenters.org	(Conservation Centers for Species Survival)
www.rhinos-irf.org	(International Rhino Foundation)
www.nature.org/ourinitiatives/regions/africa/explore/hirola-campaign.xml	(Hirola Conservation Program)

(Continued on page 393)

# Training Przewalski's Horses Using Protected Contact in a Facility with Limited Resources

By Amanda Faliano, Large Mammal Keeper  
Denver Zoo, Denver, CO

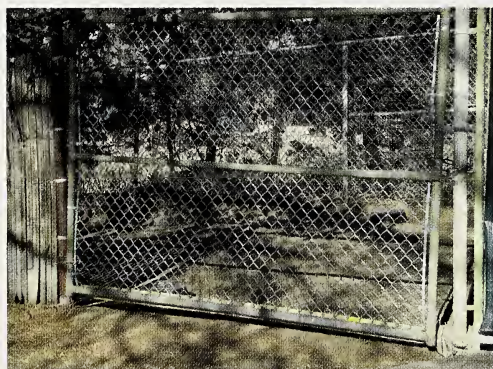
## Abstract

Denver Zoo currently houses 1.3 Przewalski's Horses (*Equus ferus przewalskii*), also known as Mongolian Wild Horses, whose training had traditionally been limited to shifting into stalls and a stud pen for daily cleaning. 0.1 Bernia has lived in Denver since 2001; 0.2 Yisun and Saikan moved to Denver in 2006; and 1.0 Bataar moved to Denver in 2008. We currently cannot do hoof trims or any medical procedures on any of the four without chemically immobilizing them. Initially, none of the animals allowed keepers near or would eat from their hand. While in quarantine, however, Bataar began showing interest in human contact, so technicians at our hospital began the first steps of what evolved into our training program for these horses. We began working formally with Bataar in September 2009, and he progressed more quickly than we anticipated. He currently presents both sides for keepers, pressing his entire body against a chain link fence, and allows injections into his hip, application of fly spray and will pick up each foot when asked. All behaviors have been trained through a chain link barrier, in a protected contact setting, using positive reinforcement-based operant conditioning. Bernia has now begun this training as well. This paper talks about the how we got to where we are today and the planned next steps to continue to build this program and work creatively within our existing facilities so that we can reduce the need to use chemicals for medical procedures.

## Introduction

The Przewalski's Wild Horse also known as Mongolian Wild Horses once ran freely across Mongolia, but due to human hunting they became extinct in the wild in 1969 (Boyd, 1994). With the help of zoos and national parks, the species was reintroduced back into Mongolian national parks in 2005. Today there are about 250 free-roaming horses and approximately 1500 of these horses total worldwide.

Denver Zoo currently houses 1.3 Przewalski's Horses. The mares came from San Diego Wild Animal Park, one in 2001 and the others in 2006. In 2008 we received a stallion from Lowry Park in Florida. Denver Zoo's enclosure consists of a one-third acre yard and barn that has an open feed room, two stalls and an attached stud pen used for holding while keepers clean the yard. Denver Zoo participates in the Species Survival Plan® (SSP) for this species, two of the three females are being allowed to breed while the third is being given an injectable birth control. None of these horses are tame. They shift into the stud pen in the morning for grain; only if needed do keepers go in with them. They are worked mostly using protected contact. Bataar, the stallion, arrived from Florida and was immediately put in a quarantine barn at the hospital for 30 days where veterinary staff cared for him. The first few days in the barn he was very nervous and aggressive. He broke out one of the stall windows to the outside by rearing up on his hind legs and breaking the glass with his nose. He was quickly given access to the outside pens and calmed down. Once he was routinely getting outside access he started to show interest in the veterinary technicians while they were cleaning. He began coming up to them and allowing them to touch his face through the stalls and taking food from their hands. When the 30 days were up he was moved to his permanent home at the barn with the mares. Unfortunately, when the mares were brought into the scenario he remembered he was a stallion and began charging anyone who approached the fence, and would herd the



Training panel in use at Denver Zoo.  
(Photo. Karen Stern Scott)



mares around being very protective. He quickly caught on to the routine of shifting into the stud pen in the morning with the mares.

Due to a lack of a Tamer® system or chute, these horses have to be chemically immobilized every few months in order for them to get a full physical and have their hooves trimmed. All vaccines are done at this time and if one is in need of a vaccine at another time they are darted. Through protected contact and operant conditioning using positive reinforcement training the hope is to not have to use chemicals to take care of these horses. Training has started with the stallion and slowly we are introducing the females to the program as well. Currently training takes place in the stud pen where the horse can be locked away from the others, preventing distractions and also preventing unwanted aggression. There is a bare gate where the horse can see us and allow us to get closer to him.

**Methods**

Why start with the stallion? Bataar showed some interest while in quarantine at the hospital and again after some time spent in the new yard with the mares.

In the beginning when the herd was on exhibit, keepers would occasionally throw horse candy or produce over the back fence. Bataar began by charging the fence but quickly changed to running up to the fence for the treats and eventually taking them from the keeper's hand. Only one of the females would do this but only on occasion. Feeding from the back continued for a while until Bataar would approach the gate in the stud pen where they ate their morning grain and again would allow the keepers to approach and would take horse candy or produce from their hands. Because he was always the last to leave the stud pen to insure he gets every last piece of grain, keepers began testing Bataar's attitude for a possible training plan.

When at the stud pen gate he greeted keepers with an eager attitude. The keepers attempted to scratch his face. A little shy at first, he quickly liked being scratched along his neck and forehead. There is a hand-sized hole in the gate where the hinges are so the keeper was able to scratch using her hand and not get it stuck. This was only doable for scratching his face and top of his neck. Once this began, a training plan was put into effect. A simple whistle bridge was trained first by bridging and rewarding with horse candy just for looking at the keeper. Horse candy and produce was his main reinforcement and scratching was a secondary reinforcement. Being very curious he wanted to smell everything including the target pole. Once the bridge was solid he began touching the target with his nose, but every time the target moved he was spooked. Smaller steps had to be taken including moving very slowly at first with the target, and using the keepers hand as a target. After a few sessions the target moving became less of a big deal and he was eager to follow it, touching it with his nose when a verbal cue of "target" was said and the target or a fist was touched to the fence.



Injection Training  
(Photo: Karen Stern Scott)

Due to a nearing immobilization, work was started on training a side presentation. The goal was to eventually be able to do a hoof trim, physical exam, and administer injections. Using the target pole to guide him along the fence, he began to line up. The goal was to have the entire right side of his body pressed against the mesh gate, making sure to press his shoulder and hip and hold steady. At first he wouldn't press his hip into the fence so a log was placed in the stud pen to help encourage him to move closer. This set him back a few days as anything new makes all the horses nervous. In order to get him used to it, the horses' morning grain was placed near the log and after a few days there was no more

fear and they even started chewing on it. Again using the target pole, he was guided along the fence and he started following it. Every day the log was moved closer to the fence causing a squeeze until he finally was pressing his hip into the fence. The log was removed and the behavior continued strongly. This only took about five training sessions, mostly working on that side. The visual cue was



an open flat right hand started in the middle of the gate and guiding him to the right using a verbal cue of "side".

Bataar needed a hoof trim before training could be finished. Therefore a hoof trim and physical could not be possible at that time, however injections might be possible. With a week to train it, a blunted needle and cap were slowly introduced. A backscratcher was introduced first to touch him through the chain link and start poking him in the hip. Once comfortable with being touched everywhere, a needle with the cap on was introduced. He had not had any negative experience with a needle so to him it was just another object. After a few times with the cap on and his hip staying pressed into the fence, the cap was removed and the blunted needle was used to allow him to feel a pinch but not have the needle able to puncture the skin. He had to rely on scratching as reinforcement due to being fasted for the immobilization. When the day came, he got injected three times with the sedative by a vet he had not seen before. He only moved slightly but didn't break from the side position. He was then shifted into the stall where the immobilization would take place, he was then pole syringed (less stressful). This way he wouldn't go down in the stud pen. Before this training Bataar and the mares had to be darted which would cause unnecessary stress before the procedure.

We began to touch him with other objects for desensitization: sticks - in case he needs to be pole syringed so he wouldn't spook; spray bottle with water - to simulate fly spray; and actual fly spray, which is still a work in progress. Over a short period of time he was allowing his keepers to touch him with the objects over his entire body and even leaning into them. Verbal cue "touch" was used for all the objects.

The most difficult behavior to be trained so far was the presentation of his left side. He would follow the target pole any way it was asked, but quickly rotate so his right hip was against the fence. A break was taken from the left hip presentation. As when his training was first started the horses were receiving horse candy from the back fence and the keeper attempted to ask for his left side where there was a long fence for him to follow. He did it on the first try, and again the next day. Using the left hand and pointing with index finger and guiding him to where his head should be (similar to a "side" cue), a verbal cue of "turn" was also added.

Next session he was brought back into the stud pen where he easily translated the behavior into the smaller area. At this time he was not asked to present his right side to prevent any confusion until his left side presentation was solid. Once solid he was asked for his right side after his left and he just shifted his hind end around barely moving his front. He could then move from left to right and back again just with verbal and visual cues.



Bataar training to pick up his feet.  
(Photo: Karen Stern Scott)

would follow the keeper breaking out of his position. A second person was brought in and Bataar's hind quarters followed the same pattern as his front had. After a few sessions with a second person he stayed in position allowing the primary keeper to leave his head and ask for his hind legs. "Lift" was used as a verbal cue and the back scratcher was used as a type of visual cue to allow him to know



Training for left side presentation.  
(Photo: Karen Stern Scott)

his left side presentation was solid. Once solid he was asked for his right side after his left and he just shifted his hind end around barely moving his front. He could then move from left to right and back again just with verbal and visual cues.

The last behavior for Bataar was is to pick up his feet. In either of his side positions his leg was touched lightly with a back scratcher with increasing pressure until he moved it. Any movement was acceptable as long as he didn't move away. As with his previous behaviors, he picked up on it very quickly. After some hard pressure was applied he began lifting his leg. Light pressure became enough just to let him know which leg to pick up. His hind legs were harder as he



which leg was wanted up. Due to horse muscles and anatomy he is not able to suspend it in the air for very long but is able to lift all four legs high, not aggressively (such as kicking) and keeping his hip pressed and ears forward.

A second person was added to each behavior before moving on to the next. Another keeper is also trained on all the behaviors and can work Bataar. He has done all his behaviors in front of small groups, and is assisting in one of the mare's beginnings. She has recently come to the fence but will not take food from the keeper's hand, though she does seem to know what the whistle means. When Bataar is bridged, she walks towards the fence.

## Conclusion

Our experience hopefully shows that no matter the set-up or the resources available, animals can be trained using protective contact. Taking advantage of an animal's interest is a first step, and basic tools such as a target to assist in the training process. This species had not had any training plans, but because the stallion showed interest, goals have been set for future training for this species at the Denver Zoo. The current facility allows a limited amount of access, but with some minor modifications to the current training fence (such as cut outs for leg access) there is hope that this training will allow a full physical and hoof trim to be completed without chemical assistance.

The zoo is currently planning to install a Tamer<sup>®</sup> system with a transfer chute to allow keepers to get closer to the mares and perform some of the necessary medical procedures. This will hopefully go hand in hand with the current training by allowing us to get closer to the mares and allowing them to get used to us being close to them, thus building a positive relationship. The Tamer<sup>®</sup> will not allow for all the procedures that might become necessary, therefore training outside the Tamer<sup>®</sup> will continue.

## Acknowledgments

Many people assisted with this training, Karen Stern Scott is the horse's primary keeper and assisted with most of the training, as well as continued training while I was on maternity leave. Thanks to the Vet Staff who started the process by taking great care of the stallion when he first arrived and was in quarantine. Thanks to the veterinary technician for recently assisting with injection training. Thank you to all the keepers who would come assist throughout the training, including Sue Peters - carnivore keeper to see if the horse would react to a different smell. And thank you to all the supporters: Dale Leeds - Large Mammal Curator; Vickie Kunter - Large Mammal Supervisor; and Emily Insalaco - Behavioral Husbandry Curator.

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*African wild ass  
Artist: Debi Talbott*

## **Training the “untrainable” -**

# **Using Natural Behavior and Positive Reinforcement to Train Husbandry Behaviors in a Gerenuk (*Litocranius walleri*)**

*By Christina Seely, Large Mammal Keeper  
Denver Zoo, Denver, CO*

### **Introduction**

Historically conditioning through positive reinforcement has been used with many different kinds of hoofstock. Bongo (*Tragelaphus eurycerus isaaci*) and Nyala (*Tragelaphus angasii*) have been crate trained to allow blood draws and injections at the Denver Zoo. Even some animals like Okapi (*Okapia johnstoni*) have been trained to free contact hoof work. As training becomes more widespread through “hoofstock” areas in zoos the question arises as to what we can train rather than what we can’t train. Conditioning of routine husbandry procedures can allow for animals to receive injections, be routinely weighed, and have blood work done when perhaps normally it would only be done opportunistically when the animal was immobilized.

### **Natural History**

Gerenuk (*Litocranius walleri*) are browsers of shoots and leaves of trees at a height of up to 2.6 meters (8.5 ft.). To reach the leaves higher in the trees, gerenuk rear on their hind legs and rest their forelegs against supporting branches. Gerenuk are unique in this ability that allows them to occupy a distinct niche (MacDonald, 2001). They live in widely open landscapes that give them free movement between shrubs and bushes avoiding thick, dense bushes, tall woodland and grassland (Estes, 1993).

### **Animal Background**

The Denver Zoo acquired 2.0 gerenuk in May of 2007; a juvenile named Woody and an adult named Gaston. Gaston is now housed with steenbok (*Raphiceros campestris*) and a kori bustard (*Ardeotis kori*). Woody is exhibited with 1.1 Abyssinian Ground Hornbill (*Bocorvus abyssinicus*) and 1.1 East African Crowned Cranes (*Balearica regulorum gibbericeps*). Due to the Abyssinian Ground Hornbills it is often necessary to enter the exhibit with all animals to retrieve items dropped in by the public, as the hornbills tend to pick things up and potentially swallow them. To do this Woody would need to be relaxed around anyone who may enter the yard. Woody was hand-reared at the L.A. Zoo with siblings and transferred to the Denver Zoo. When Woody arrived his notes from L.A. said he was “nervous and flighty”. Once in Denver he exhibited the same flighty behavior. Gaston was parent-reared at the L.A. Zoo and transferred to the Denver Zoo. Gaston’s notes from L.A. said he was “tractable”.

### **Materials and Methods**

The two were quarantined at the barn where later Woody would stay. The quarantine stalls were 15 ft. x 13 ft. [4.57m x 3.96m] concrete stalls with a single skylight, heater, and drinker in each stall. Per quarantine protocol, they were not allowed in the yard for a month. To help enrich them in their stall, keepers would rotate different objects into their stalls about every third day. Woody would be shifted into stall #2 while keepers cleaned. Keepers would then add the new item to stall #1 with reinforcement of apples, pears, and carrots which were always gone by morning. Woody was then given the option to shift towards the new object, but was never forced. Once he actually shifted over he was locked into stall #1. It took 5-20 minutes for Woody to shift. The same protocol was followed for Gaston’s shifting and cleaning. Gaston’s items were put into stall #2 while he was in the breezeway. One day it could be a cylinder, another day an upside down feed tub, anything that would make them take notice when they were shifted back over into their stalls. (Fig. 1)

With the help of interns who were always willing to hand feed an animal, Woody and Gaston quickly began coming up to a small 3 in. x 3 in. [7.62cm x 7.62cm] mesh-covered hole that could be opened for treat giving. Keepers worked on opening the door used to maintain the stall and encouraging them over with food. It turns out the full body of a keeper was scary to Woody and it took some time



for him to adjust. Keepers began putting Woody's grain pan just inside the door with him in the stall to encourage him to be calm around people. After a week, he did begin coming over and taking treats from the sliding door. Once he began coming over, different people were always encouraged to offer him treats.

Over time both gerenuk were out of quarantine and introduced to the exhibit and the birds. The two boys were never put together. They were introduced to everything separately and yard access was rotated between the two of them. They were first introduced to the cranes because, though the gerenuk are tall, they would shy away from the cranes. They were given access to the stud pen where they could watch the cranes while they were on exhibit. After a day they were then introduced to the hornbill that would continuously come to the stud pen and check them out and bring them items such as sticks and rocks from the yard. Continuing Woody's conditioning keepers began going out on exhibit with him on a fairly regular basis and hand-feeding him so that he would continue to remain calm around people. Gaston had no problem with this as he was walked in at his other zoo, so humans in his space seemed okay with him.

### **Crate Training**

After quarantine was completed, it was decided that Gaston should go down to another barn so that both gerenuk could go onto exhibit daily rather than rotating them into the one yard where they had been quarantined. Keepers were given 10 days to crate-train him, otherwise he was to be trailered and moved to the other barn. Keepers took on the challenge of crate-training him because of the possible risk of injury of running such a flighty, delicate animal into a horse trailer. A crate was put in the stall #1 with one end butted against the shift door. This took place about two weeks earlier. The crate was 4 ft. long x 2 ft. wide x 5 ft. tall. (Fig. 2)

Day 1: Gaston was locked in stall #2 overnight and east crate door was left open. Treats were put into crate and by the next morning he had eaten the treats half way into crate.

Day 2-3: Gaston was given access through and around the crate for the day and into the crate from east side overnight.

Day 4: Gaston was given access to crate with both doors open and shift door closed down to encourage him to walk through between stalls. He went through and received treats.

Day 5: Gaston was given access to the crate all day. He walked through the crate a couple of times throughout the day. Keepers tried to get him into crate with keeper present with no luck.

Day 6: Keepers put grain in crate to encourage him to go in. Access was given to crate all day. Gaston went into crate overnight and ate his grain.

Day 7: Given grain in crate again and was seen all the way in crate at the end of the day.

Day 8-9: Went into crate right away for grain at night feeding.

Day 10: Gaston crated very quickly once treats were put in. Keepers attempted to shut him in but door jammed. Keeper went in and fixed door. He went in again and door was easily shut behind him.

### **Up, Touch, and Blood Draw:**

Woody became so calm and so easy going that keepers began to think about what else he might learn. Keepers continued to use pieces of apples and pears that he seemed to enjoy...until grapes were used and now he won't train for anything else. Starting out small, keepers asked him for "up" which consisted of him performing his natural gerenuk behavior of standing on his back feet and bracing against a tree in the yard with his front feet. He was originally baited into this position that was easily accomplished in one session. After a couple of sessions of asking him for "up" the keeper began moving from tree to tree in the yard and would call his name to get him to follow. After a little tail wag he would come down from his "up" position and walk behind the keeper to the next tree. Again this was accomplished very quickly as he thoroughly enjoyed his grapes. Once in the "up" position, the keeper started to say "touch" and would touch the front leg closest to them. Woody's first reaction was to remove his leg from the tree but he did not break position on the tree. When asked a second time he allowed the keeper to touch him. He did the same thing with the opposite leg. Continued touching of his front legs for a couple more sessions then moved on to touch his neck, sides, and belly. The keeper was able to continue training and touch Woody's anus, genitals, orbitals, and ears. The keeper was also able to say "touch" and touch Woody's shoulder and walk behind him while he was in position on a tree.

A second keeper was brought in to become the primary and reinforce Woody while the first keeper continued touching and working on bending down to touch his back legs. Keepers slowly began desensitizing him to being poked with a key and then later a blunted needle along the lateral saphenous vein on his lower back leg. Duration of poking and holding off on the vein was established before a third person was added. This person was always different and was meant to substitute a vet's presence. After Woody proved to be calm with a number of different people in the yard with him, a vet and vet tech were asked to come in and test to see how ready he was for a blood draw. The vet was able to get blood that day. She used a 22-gauge, one-inch needle on a 3ml syringe and she drew blood from the lateral saphenous vein. The first poke he did break from his position on the tree, but when asked to "up" Woody got back up on the tree and the vet was able to repoke him and draw his blood. Woody was never restrained or sedated through any of his training.

Later it was decided that we have only a primary keeper and then a second person would always be different and stand in for the vet. This actually worked better as training became more consistent and Woody very quickly became calm around lots of different people. Anyone he wasn't initially comfortable with was asked to feed him a few grapes, let him smell them, and then he was ready to work.

### **Other Behaviors**

After getting blood we began working on injection training. The same concepts were used. He was asked to "up" and was desensitized to being poked in his upper thigh for an intramuscular injection. An actual injection is still in the works.

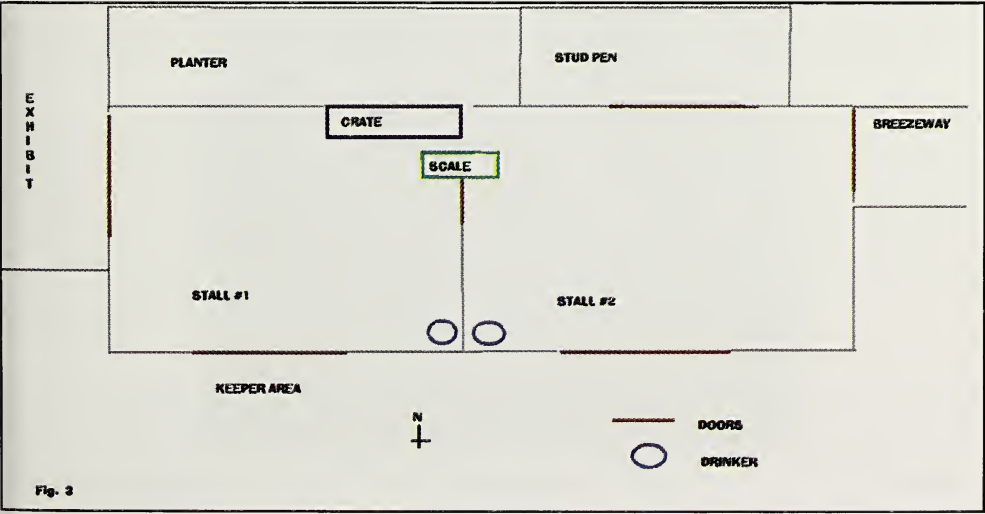
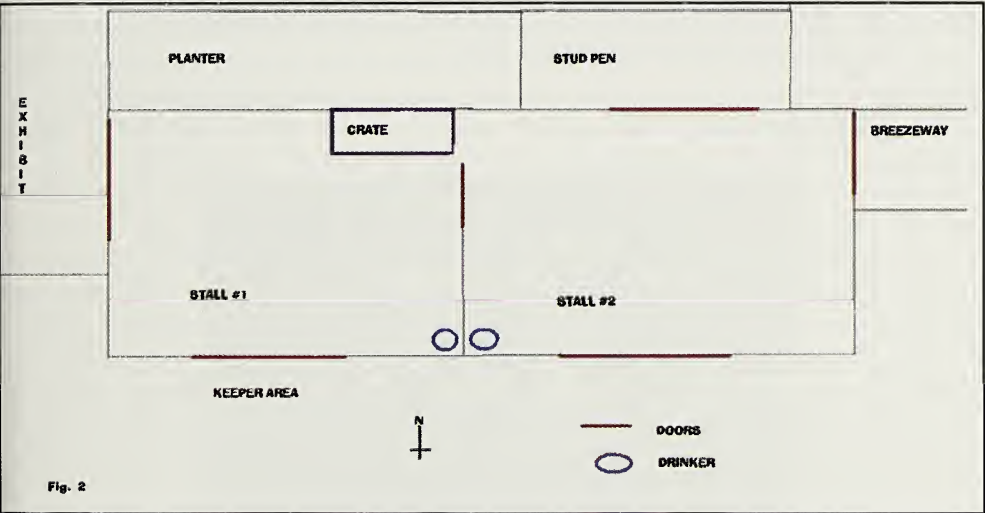
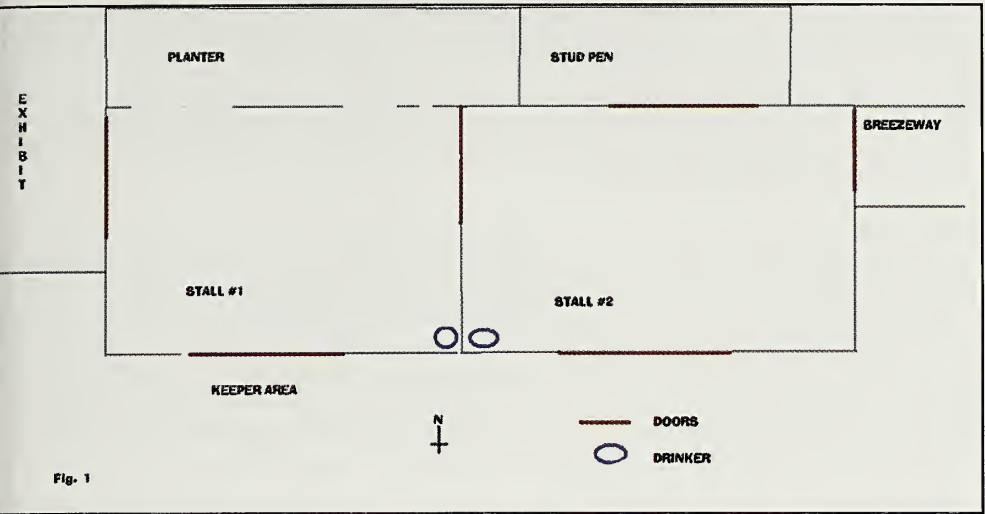
While all this training occurred outside, Woody was also trained to be weighed in his stall. Woody has two large stalls with a door that can be closed to separate them. His bed and alfalfa is on one side and his grain and produce is given on the other. The scale used had a slick surface so a mat was taped to it to insure he was steady on the scale. First, the mat with a small bit of shavings was placed in the doorway between the two stalls and treats were put on and around it to encourage him to check it out and walk around it. The mat was left that way over night. After three nights of this the door was closed down close to the mat to make sure that if he walked from stall to stall he was walking over the mat. Again treats were used to encourage him. This step was left like this for a three nights to ensure calmness. The next step was to reopen the door between the stalls all the way and add the actual scale under the mat. The mat was taped to the scale. Treats were put on and around the scale. This set-up was left overnight for four nights. Again the door was closed down on the scale to ensure that if he moved from stall to stall he would walk over the scale and treats were put on and around it to reinforce him. After four nights keepers went into the opposite stall Woody was in. They brought the cord to plug in the scale reader and the reader itself. They then plugged everything in. Keepers had grapes to reinforce him and were ready to read his weight. Keepers were able to bait him onto the scale and get his weight on the first attempt. Woody has been weighed every month since then. The scale is put in between the two stalls and the door shut down on it. It is usually left overnight for him to check it out then he usually gets right on. He can now get on the scale by pointing at the scale and using the verbal cue "scale". He no longer needs to be baited. (Fig. 3)

Due to the Colorado winter, Woody has also begun learning to repeat his blood draw and touch behaviors inside. Because of slick walls and floors some modifications were made such as a mat to stand on and a "tree" hung on the wall. The "tree" consists of seven lateral and three horizontal wood pieces mounted together on a wall. Training these behaviors indoors has slowed a lot, perhaps being inside makes him feel trapped compared to his wide open space where he traditionally worked these behaviors. Woody is also learning to target and for fun is learning "no" and "yes". Keepers have done talks in the front of the exhibit with him and even private tours where people can come to the back of his exhibit and feed him. He even does "up" on the back mesh fence and allows these tours to feed him while doing his *gerenuk* behavior.

### **Results**

What started out as merely desensitizing an animal to different things in hopes of relaxing his flight response, ended up opening up new options in training. Through positive reinforcement Woody is now trained to get on a scale on cue, stand for a blood draw, and allow body checks. Just by calling his name he also goes to a fence line in the back of the exhibit to receive treats from special tours.





These groups so far have been able to be any size, as long as they have treats. It has allowed keepers to talk to members of the public about an animal that many are intrigued by due to their unique ability, but few are able to see that close. Because of his ability to be weighed, keepers have been able to closely monitor his weight while the zoo went through a grain change when many other animals were unable to be monitored through weight checks. Because of this keepers caught a slight weight loss and were able to do something about it and start things in motion to monitor the other animals on the new grain more closely.

### Conclusion

Training has now begun with our other gerenuk Gaston. He comes to keepers offering him treats inside, is working on "up", and has been baited onto a scale. Although he is not as far along as Woody, he also hasn't been training as long. The ability to train Woody free-contact has now made it realistically possible for yearly vaccines, monthly weight checks, and routine blood draws. He has also opened up the possibility to other gerenuk being calmed and trained. As training husbandry behaviors becomes more common in the zoo world, it begins to become excitingly obvious that there are very few, if any, untrainable animals in our care. Though sometimes difficult and time-consuming, one should never assume a species is untrainable.

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The author and 1.0 gerenuk "Woody"  
(Photo: Dave Parsons)



# *Goat Lab - Evolution of a Training Class*

*By Elizabeth Abram, Keeper II  
Oakland Zoo, Oakland, CA*

The Oakland Zoo offers several classes tri-annually for participants in our Zookeeper Intern and Apprentice programs. The program offers the opportunity to gain valuable skills through on-the-job training and classroom learning for people who are interested in pursuing a career as a zookeeper. The classes cover aspects of zookeeping, such as Studbook and Population Management, Behavioral Observations, Animal Capture and Restraint, Enrichment and Training in a Zoo Setting. The classes are taught by senior members of our Animal Management staff. I teach the class "Training in a Zoo Setting" along with my Supervisor Margaret Rousser. The training class began as a lecture-only class taught by me in a classroom setting. Topics covered included the ways animals learn, why we train, training considerations and what to train. The class would be followed up with the training game.

As more students went through the class some of their questions led me to believe that I may not have explained certain training terms and theories to their satisfaction. At one point our class had to be held in an office due to lack of classroom space. The office was located in close proximity to the goat barn and I realized that I could better answer some of these questions through demonstrations with the zoo's contact yard goats. The students could better learn the material by hearing the explanation of operant conditioning techniques and then seeing those techniques in action. We went upstairs to the contact yard, brought a goat into a holding yard and shaped a "stand in a feed bucket" behavior. The students were able to see shaping and capturing occurring in the moment. At the same time, I was able to narrate the training process, explaining what I was doing and why. I then let some of the students operate the clicker and shape a simple behavior. From then on, after each lecture the class would do hands on training with the goats. We chose random behaviors that wouldn't have an effect on established veterinary or husbandry procedures. Along with shaping the "stand-in-bucket" behavior, we added nose and body targets and stationing. One participant, a professional dog trainer, suggested using dog agility equipment to add more novel behaviors. She provided us with some of her used materials such as large and small hoops for standing on or jumping thru and a long nylon tunnel. The zoo used enrichment funds and bought dog agility weave-poles and the staff made some items like jumps and a see-saw out of materials we had on hand. Soon we had a fun hodge-podge agility course for our animals!

The class now consists of two parts, an in depth training lecture offered by Margaret followed by hands on training with me at the goat barn. Most of the goats are able to complete the entire agility course (Jump over an obstacle, walk under an A-frame "tunnel," climb up and down a series of steps, walk over a see-saw, jump onto a stanchion, weave through poles, jump through a hoop and stand on a log, etc...) as a chained behavior, each part having been trained separately. As time goes on we come up with more non-essential behaviors such as circling to the right or left and turning around inside a bucket.

The zoo has three paid Apprentice positions and individuals who have come through this program have also benefitted from the Goat Lab. The animal keeper paid Apprentice is a six-month position designed to further train aspiring keepers and give them more in-depth experience as well as allow them to assume added levels of responsibility. The Apprentice is expected to learn and be responsible





Fizz going over see-saw



Fizz jumping



Fay standing in hoop

# **GOAT** **LAB** **IMAGES**



Fay going through weave-poles



Fay heading over see-saw



Bob being lifted for stretch



Bob's leg stretch

*Photos by  
Chelsea Williams*



Joseph standing for hoof trim



for all the basic goat barn duties. The apprentice is expected to develop knowledge of the natural history of the species under their care, to conduct ongoing assessment of their physical and psychosocial needs, and to design and implement steps to address these needs. Work ranges from the physical tasks associated with feeding and maintenance of living areas to more analytical tasks such as enrichment and husbandry training. Guest interaction and education is another important factor of our Apprentice's job in the contact yard. Answering questions, showing the proper way to interact with our animals and sharing general knowledge enhances our guests' zoo visit and allows visitors to have a more personal experience. While working at the Goat Barn they get experience maintaining already trained husbandry behaviors of the goats and sheep and during an hour-long after work session, they get to train new behaviors, under my supervision. During these sessions we work on the agility course behaviors as well as husbandry behaviors such as standing for medical examinations and cooperative hoof trims. The Apprentices are allowed to come up with a behavior, write a plan for approval and implement the plan.

Current projects include conditioning a stationing behavior and desensitization to the cutting of an abnormal portion of horn with a gigli wire, and a stretching behavior for a goat with tendon issues that involves him voluntarily being lifted in a sling for support during the stretches. Recently we've added our domestic guinea hogs (*Cavia porcellus*) to the program with head stationing for eye washes and tusks cutting. As all of the goats, sheep and pigs have different personalities ranging from lap dog-type behavior to wild and flighty impala-like behavior, apprentices are able to build skills with fearful animals (resembling many prey species) as well as confident sometimes aggressive animals (more similar to carnivores). The animals benefit from the extra attention and mental stimulation provided by the agility course as well as maintenance of their husbandry behaviors. As the primary keeper responsible for the behavioral management of 16 contact yard animals along with the several other species, I get the additional help with my training program. Most of my animals are domestic and their training often comes in second place to the training of exotics, such as Ring Tailed Lemurs (*Lemur catta*). With this extra help we've been able to expand our domestics training; one result of this is the elimination of hand-grabbing of goats and sheep for routine hoof trims. Our apprentices get to develop and implement training plans with the supervision of senior keepers, while we get to hone our teaching skills as well, with our human and animal learners. Overall, the Goat Lab has turned into a fun and enriching project for all species involved.

### **Acknowledgements**

Thank you to: Oakland Zoo Contact Yard Goat Superstars: Colleen Kinzley, General Curator; Margaret Rousser, Zoological Manager; Alan Foster and Chelsea Williams, String 7 Keepers; Amy Phelps, Keeper II and Intern Coordinator; Lisa Clifton-Bumpass - CCPDT, OZ Volunteer; and the Contact Yard Interns and Apprentices.

# Elevating Warthog Care Through Training

By Morgan Lashley, Animal Care Specialist and  
Christy Layton, Associate Animal Care Specialist  
Busch Gardens, Tampa, FL



The philosophy at Busch Gardens is training can occur at every interaction and positive reinforcement is used in teaching behavior. An opportunity arose to formally train 1.1 Warthogs (*Phacochoerus africanus*) using protected contact under the supervision of Jay Stutz, Assistant Curator of Behavioral Husbandry. The warthogs, Gamba, 1.0 age 12 and Link, 0.1 age eight had previous training which included targeting and recall. Gamba was food aggressive whenever diet or enrichment was presented on the habitat or in the barn. He would also not allow Link to forage for her diet. This obstacle could not be overcome by separating the warthogs because Link would pace and become distressed. Link was also cautious about approaching the trainers to receive either diet or enrichment. She would cower in fear that Gamba would displace her and be reinforced by obtaining the food. One goal of our training was to chute train the warthogs so veterinarian husbandry procedures such as blood draws, ultrasounds, and minor physicals could be performed without the use of anesthesia. In previous physicals Gamba encountered problems waking from the anesthesia. Two other goals that evolved during training were to decrease Gamba's food aggression and to calmly separate the warthogs.



**Fig. 1.** Training stationing behavior  
(Photo: Jay Stutz)

Training was initiated with the introduction of the bridge (Conditioned Reinforcement, CR) and stationing. Two bridges were chosen (one for each animal), the whistle and the clicker, due to the acoustics of the concrete barn, where training was to take place. Both warthogs identified their specific bridge in only five sessions over a two-week period. As training progressed Gamba's food aggression began to decrease because he was focusing his attention on the trainer. Link began approaching the trainers with less hesitation because Gamba was under control of the trainer. Stationing was the first behavior trained (Figure 1). Each warthog had its own station that was a different shape and color. Link and Gamba quickly learned stationing. After

ten sessions, about two weeks, Gamba and Link were consistently responding to the stations even when we switched trainers during a multiple session day. Subsequently the time they were held at their specific station was also increased. Gamba was held at the station for an average of 30 seconds before receiving CR and food reinforcement. With the warthogs stationing response at about 90%, we then added the chute to their training program.

Gamba, who had shown interest in the chute earlier, was chosen to begin training first (Figure 2). Using the blue square station to move him around, he was easily shifted in and out of the chute. Tactile was used as the positive reinforcement (Figure 3). His body language, closing his eyes and moaning, showed us he was very relaxed. Link was the opposite. She had a negative history in the chute, due to a minor conflict with Gamba prior to this training. To overcome this obstacle, Gamba had to be under control on the opposite side of the barn, and the chute had to become highly rewarding.



**Fig. 2.** Gamba uses target to shift in and out of chute (Photo: Jay Stutz)





**Fig. 3.** Reinforcement included tactiles.  
(Photo: Jay Stutz)

Unfortunately, crates for shipping the warthogs were not available at the time of training, but would be delivered upon shipment. In lieu of a crate we created a confined space by using the chute that was already in place (Figure 4). Protected contact procedures at our facility prohibit us from entering the barn with the warthogs to assist in loading them in the crates. This was a temporary situation, so we used materials that were available. Different materials that



**Fig. 5.** Personnel gate attached to chute.  
(Photo: Christy Layton)

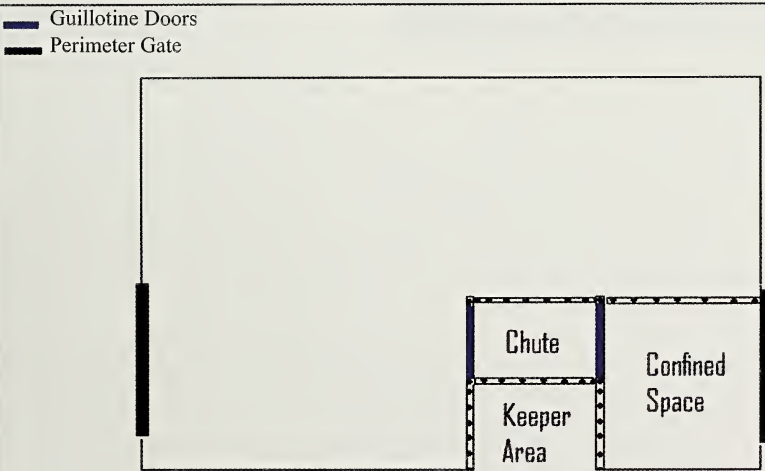
We began moving the station closer and closer to the chute and, once Link was in the chute she was then heavily reinforced with food (Primary Reinforcement, PR). Tactile was not an effective reinforcer with Link. Over time her confidence level increased in the chute and Link would approach the chute with less hesitation and fewer PR were needed to work her into the chute.

After two months of training, our leadership team informed us the warthogs were being moved to another facility. Considering the prior medical history of the animals, immobilization was not an option for shipment, thus adjustments needed to be made to our training plan.

we tried, but were not suitable for safely confining the warthogs were chain link and wire mesh. After discussing our ideas with our colleagues, it was suggested using a chain link personnel gate that was 91.44cm x 182.88cm. (Figure 5) This gate was attached to the chute and the perimeter shift gate using steel wire. To make the gate sit



**Fig. 4.** Confined space used for training. (Photo: Morgan Lashley)



**Fig. 6.** Layout of training area

level, a wooden block was placed against the chute to rest the gate on for support. The confined space was 121.9cm x 152.4cm and large enough to hold both warthogs at the same time. To enter into the confined space the warthogs had to go through two guillotine doors. These doors were only open during training sessions to prevent incidents from occurring when the warthogs had access to the barn without supervision (Figure 6).

After the modifications were made we could then begin our training for shipment. By over training the behaviors of stationing and entering the confined space, we would be able to ask less of the warthogs on the day of shipment and the warthogs would still be able to succeed even with all the extraneous variables that would occur. We increased training to several times a day and during these sessions the chute behavior became the main focus with both warthogs. Gamba was worked in the confined space first since he had a stronger reinforcement history in the chute. This would allow us to work Link without Gamba interfering. Unfortunately, Link would linger in the chute and was hesitant to enter the confined space with Gamba present. To set Link up for success we shifted our strategy and began focusing our approximations on bringing Link into the chute first. Gamba continued to work on remaining at station for an excess of 30 seconds while Link was worked in the chute without distractions. The day prior to shipment, the warthog were worked together in the confined space for the first time. The warthogs were heavily reinforced, then brought out of the confined space.

On the day of shipment, we found that the unsuitable crate had been removed and a new crate was present. The warthogs were hesitant in approaching the trainers because this was the third day of being held in the barn with no access to the habitat. The presence of the new crate was also a factor in their reluctance. Along with Jay, we tried to keep the training session as normal and routine as possible. However, the extra keepers and summer campers were outside the barn to observe the shipment and one of the veterinarians had entered the barn prior to the training session. This alerted



**Fig. 7.** Warthogs Link and Gamba are both in the confined area for the first time. (Photo: Morgan Lashley)

the warthogs that something different was happening. We started the training session with very simple commands. Gamba overcame his apprehension and approached the trainer. Meanwhile Link was reluctant to approach the chute and trainer. After approximately half an hour Link finally entered the chute and was able to be walked into the confined space. Once Link was in and secure, Gamba was stationed in front of the chute. Jay opened the first guillotine and Gamba walked through. Once he was half way through the chute, the second guillotine door was opened to allow him to enter the confined space. Both doors were closed, securing both warthogs in the confined space for the first time (Figure 7). One crate was then attached

to the opposite side of the chute. At this time the trainers kept the warthogs calm, reinforcing only appropriate behavior, while the support staff secured the crate. Link was shifted into the crate first contrary to the plan because of minor aggression that occurred due to length of time the warthogs were kept in the confined space. Once Link was secure in the crate the next crate was brought in. Lastly Gamba was then shifted through the chute and into the crate. We were able to successfully load each warthog easily into the separate crates with little stress on the warthogs and the keepers.

In conclusion, the warthogs were successfully loaded into the crates without the use of immobilizing drugs. During the three months of training, Gamba was able to overcome his food aggression during training sessions. Link also became very responsive to trainers to the point where she would actually lie down. We were excited that she would put herself in a vulnerable position, even in the presence of Gamba. We were also able to capture the behavior and put it on cue. Due to the dedication and ingenuity of the trainers, a confined space was created to ease the stress of loading. Through the elevated animal care and our facility's philosophy, we were able to successfully complete the task of loading the warthogs using positive reinforcement techniques and no drugs or anesthesia.



# What's This Ungulate Care Workshop I've Been Hearing So Much About?

*By Adam Eyres, Hoofstock Supervisor  
Fossil Rim Wildlife Center, Glen Rose, TX  
and White Rhino SSP® Coordinator*

We're glad you asked, but the real question is 'what are THESE ungulate care workshops I've been hearing so much about?' It all started a few years ago when a group of dedicated antelope people were discussing the perceived loss of a skill set for working with ungulates. Yes, some of us have been doing this for a while, and yes, you may have heard stories about how we used to have to catch large antelope bare-handed after chasing them uphill through the snow. While some of us may be prone to spinning yarns, there is a nugget of truth to this. As our field has changed over the years, older staff have moved on without passing on all of their knowledge to their replacements. Institutional changes mean that keepers are often required to be generalists, and don't get specialized training working with just one taxa anymore.

In the discussions that followed, we tried to identify what skills aren't being learned anymore (or used as much as they should be) and more importantly, how do we get these skills back into the hands of the folks who need them? Each institution has its own history and experience of what works for them. Although there are definitely WRONG ways to do things, there is often more than one way to accomplish your goal. What we really want to do is teach people what is possible, in order to give them more tools they can use when working with animals in their collections.

We felt this was important enough to keep discussions going. We also talked with a wider variety of people to identify the specific skills they would like to learn, or have their staff learn. We ended up with a list that includes hoof care, conditioning hooved species (for a variety of purposes), hand-rearing ungulates, working with mixed species of ungulates, the handling of animals that have been chemically restrained, hand capture and restraint of animals without chemical assistance, and working with some of the specialized equipment designed for working with hooved animals (like the Tamer® chutes). As a group, we all agreed that it was important to find a way to share this knowledge with the future dedicated antelope people.

This has not been a simple process. We had to figure out how to design the workshops, how to get the information out to the zoological community, how each course would be structured, how to house the students, how much these courses should cost, etc. Each of our institutions has its own strengths, and we decided to offer the experience of working with our animal management staff to keepers from other institutions. As of 2011, there are six institutions offering specialized Ungulate Care Workshops—and others that are still planning to do it in the future. The Oakland Zoo, Los Angeles Zoo and San Diego Safari Park are all offering courses on the west coast and Saint Louis Zoo, The Wilds and Fossil Rim Wildlife Center are offering courses further east. More details are available on the Antelope TAG web site ([www.antelopetag.com](http://www.antelopetag.com)). The very first person to attend a workshop was Erin Schaefer from the Denver Zoo and she had this to say about her experience at San Diego and how she came to be involved. "A fellow keeper brought the Ungulate Care Workshop brochure back from the AAZK National Conference and I knew I wanted to be a part of it. I have grown up with hoofstock and throughout my zoo career have envied primate and elephant keepers that have taxa-specific workshops. Finally a chance for hoofstock keepers to gain knowledge and skills specific to the species we love. I went to the San Diego Zoo and Safari Park for three days. It was an awesome

experience to see the vast number of different ungulate species and how they are managed. I got to help hands-on with a field knockdown and see a Tamer® and chute set-up for care and procedures. If you love hoof stock and want to experience a unique opportunity and gain skills and knowledge this is the workshop you've been waiting for."

Find a course that offers the specific training that you want to round out your hoofstock keeping skills, or choose a facility that you'd like to visit. Curators and directors are learning about these opportunities as well and we're sure that they will see the value in additional professional development for their ungulate care staff. Courses vary in length, number of students, amount of hands-on work, price, and obviously, what you'll be learning. If you want to trim a deer's hoof or palpate an addax in a drop-floor chute; hold a red deer's head while he is waking up from anesthesia or just get a LOT of hands-on experience working with a duiker or pronghorn—Ungulate Care Workshops are the place to go.

### ***Addendum from Amy Phelps, Oakland Zoo, Oakland, CA***

This June the Oakland Zoo hosted its first Ungulate Care Workshop on ungulate hoof care. Twenty-seven keepers, curators, veterinarians, and veterinary technicians traveled from all over the country to spend three days examining hoof care and trimming procedures for captive ungulate species. The Oakland Zoo's Director of Veterinary Services, Karen Emanuelson, DVM taught the anatomy and physiology portion of the workshop, while farrier Scott Bell led discussion and activities covering the biomechanics of the hoof, tool use, trimming techniques, and innovative management strategies for maintaining overall hoof health. Oakland Zoo Volunteer Training Consultant Lisa Clifton-Bumpass reviewed re-inforcement training concepts to facilitate cooperative foot care.



Workshop attendee Erin Shaefer from Denver Zoo with a bontebok



Attendee Joe Shepherd trims a goat's hoof



Attendee Dana Urbanski works with Amy Phelps to file a giraffe's hoof

*Photos by  
Erik Beckman*



Students observed training and trimming sessions with giraffes and goats and also had opportunities to practice hands-on trimming with these species. An afternoon of cadaver trimming gave the students real practice with feet from domestic cattle, tule elk, common eland, warthog, and black tailed deer.



Oakland Zoo Farrier Scott Bell trims a giraffe with help from Amy Phelps.



Workshop attendees practice their trimming skills on cadaver feet

*Photos by Erik Beckman*

The workshop was an exceptional networking opportunity filled with a free-flowing exchange of ideas and creative management strategies for ungulates! For information on future offerings of this workshop contact Amy Phelps at [APhelps@oaklandzoo.org](mailto:APhelps@oaklandzoo.org).

## Ungulate Websites *(cont'd from page 375)*

[www.wildcamels.com/](http://www.wildcamels.com/)

[www.aza.org](http://www.aza.org)

[www.neaasg.org](http://www.neaasg.org)

[www.iibce.edu.uy/DEER](http://www.iibce.edu.uy/DEER)

[www.moray.ml.duke.edu/projects/hippos/](http://www.moray.ml.duke.edu/projects/hippos/)

[www.camelidosgecs.com.ar/](http://www.camelidosgecs.com.ar/)

[www.tapirs.org/](http://www.tapirs.org/)

[www.wildcattleconservation.org](http://www.wildcattleconservation.org)

[www.americanbisonsocietyonline.org](http://www.americanbisonsocietyonline.org)

[www.rhinokeeperassociation.org](http://www.rhinokeeperassociation.org)

[www.pages.usherbrooke.ca/mfesta/iucnwork.htm](http://www.pages.usherbrooke.ca/mfesta/iucnwork.htm)

[www.asianwildcattle.org](http://www.asianwildcattle.org)

[www.data.iucn.org/themes/ssc/sgs/pphsg/home.htm](http://www.data.iucn.org/themes/ssc/sgs/pphsg/home.htm)

[www.iucn.org/about/work/programmes/species/about\\_ssc/specialist\\_groups/directory\\_specialist\\_groups/directory\\_sg\\_mammals/asghome](http://www.iucn.org/about/work/programmes/species/about_ssc/specialist_groups/directory_specialist_groups/directory_sg_mammals/asghome) (IUCN/SSC Antelope Specialist Group)

[http://www.iucn.org/about/work/programmes/species/about\\_ssc/specialist\\_groups/directory\\_specialist\\_groups/directory\\_sg\\_mammals/ssc\\_equid](http://www.iucn.org/about/work/programmes/species/about_ssc/specialist_groups/directory_specialist_groups/directory_sg_mammals/ssc_equid) (IUCN/SSC Equid Specialist Group)

(Wild Camel Protection Foundation)

(Association of Zoos and Aquariums)

(IUCN/SSC Antelope Specialist

Group/ Northeast African Subgroup)

(IUCN/SSC Deer Specialist Group)

(IUCN/SSC Hippo Specialist Group)

(IUCN/SSC South American Camelid

Specialist Group)

(IUCN/SSC Tapir Specialist Group)

(Wild Cattle Conservation Organization)

(American Bison Society)

(International Rhino Keeper Association)

(IUCN/SSC Caprinae Specialist Group)

(IUCN/SSC Asian Wild Cattle

Specialist Group)

(IUCN/SSC Pigs, Peccaries and

Hippos Specialist Group)

# Freezing Browse for Year-round Feeding of Giraffe and Other Hoofstock

By Pearl Z. Yusuf, Asst. Curator, Hooves and Horns  
and Sarah Mascianica, Senior Keeper  
Zoo New England, Boston, MA

## Introduction - Treatment for healthier rumen

In the summer of 2003 Beau, Zoo New England's four-year-old Maasai giraffe (*Giraffa camelopardis tippleskirchi*) was noted to become increasingly thin despite little or no change in appetite or consumption. At the time, veterinary staff were concerned that this wasting may lead to Peracute Mortality Syndrome (PMS). This is a condition characterized by complete loss of body fat. At this time, Beau was receiving close to 10kg of Zoo Herbivore Pellet daily (an alfalfa-based pelleted grain). Further indications we noticed in Beau were ketones and crystals in urine samples and as his condition progressed, occasional trembling and lethargy.

Consulting with veterinary nutritionists, our Director of Veterinary Services began developing a diet revision. Being told no giraffe had lived more than 18 months after the onset of symptoms, we all were determined to do whatever we could to help Beau. The eventual diet, evolving over the next two years is largely credited with the survival of this animal where the initial prognosis was quite grim. The details of the new diet development would be best described in another publication where a proper analysis could be discussed more appropriately. For the purpose of this writing, it suffices to say the improved diet was designed to increase his protein and digestible fiber intake (e.g., higher quality alfalfa hay was obtained and beet pulp, a lower starch grain and butternut squash became important elements); increase his salivation (e.g., offering part of his diet in a puzzle feeder would simulate natural tongue use and aid digestion); reduce the amount of concentrate pellets (thought to possibly be causing rumen acidosis); and provide necessary supplements (including sources for vitamin E, calcium and other minerals). Additionally, providing daily browse achieves both goals of altering the fiber source and increasing salivation. Beau's former diet and current diet are presented in Figure 1.

**Figure 1. Male Giraffe Diet Pre- and Post-Wasting**

Beau Original: 10 kg concentrate (Zoo Herbivore Pellet) Free choice alfalfa Trace mineral salt block
Beau Current: 6.4 kg squash strips with free choice BP on top 4.5 kg greens 1.4 kg squash cubes 6.4 kg Mazuri Wild Herbivore Hi-Fiber Free choice alfalfa
BP Mash**: Free choice BP 0.9 kg linseed meal 2 L water 1.4 kg cooked squash 1.4 kg bananas 1 c molasses **Quantity should increase/decrease based on previous night's consumption
Supplements: 2 banana skins filled with Karo syrup (prior to periods of increased activity as in the first time outside in spring) 18 ml vitamin E 227g baking soda 0.5 c Min-a-vite 204g Megalac 15 Tums (extra strength)



**The Challenge of Acquiring Browse – the right stuff**

Part of the new diet was to offer browse daily, where before it was fed opportunistically as enrichment. Browse is a general term used for leaves, stems and bark of trees and other plants. These may be given in whole or in part as a diet supplement for those animals whose natural history includes its consumption. The challenges in daily browse feeding included identifying appropriate species, finding the time to cut, finding a large enough resource from which to draw and designating storage area.

A list of acceptable browse was referenced with local species available. The ZNE browse list for giraffe is listed in Figure 2 in order of preference. This list does not reflect all browse available but is more specifically what the giraffes prefer.

**Figure 2. Browse list and feeding guidelines**

Browse Guidelines for Beau Giraffe

Below is a list of browse that may be fed out to the giraffes. Due to Beau’s finicky nature, they are separated into a list of usual favorites and a list of hit-or-miss. The idea of this list is to guide you in the right direction for feeding Beau browse he will be most likely to enjoy and consume. This is by no means an absolute list; things may change with time.

The list of usual favorites are fairly safe bets, meaning he is more likely than not to eat any of these options on any given day; but we have seen him ‘go off’ several of these choices. The hit-or-miss list means that we’ve seen him reject these options more frequently, so they should be paired with browse from the usual favorites list. Hit-or-Miss is based on his history also and can change. So if you find something he loves, we can consider working it in as a “Usual Favorite” over time.

Most importantly, **know the recent history** of what he has or has not been eating as the main deciding factor when picking out browse.

Usual Favorites:  
Aus (willow hybrid), Beech, Bramble, Forsythia, Grapevine, Knotweed, Russian Olive, Sugar Maple, Willow, Witch Hazel

Hit-or-Miss:  
Amur Maple, Bamboo, Birch, Butterfly Bush, Elm, Hackberry, Honey Locust, Mulberry, Silver Maple, Sumac, Sycamore Maple, Tulip Poplar

As all departments of the zoo became involved in acquiring this resource for Beau, appeals went out to zoo members, interested members of the public, landscapers and local businesses soliciting cuttings from our list of tree and shrub species. There was a caring response from the public, but coordinating donations was problematic. Landscapers were limited by what their clients needed. Local cemeteries and nurseries were eliminated as a source due to pesticides used in cultivating and maintaining their collections. Fortunately, keepers discovered Beau had an eager appetite for Japanese Knotweed (*Polygonum cuspidatum*). Knotweed is a fast growing invasive perennial in the Northeast US. Harvesting this plant was not only an asset for the giraffes but complimented the goals of local park management. Despite our constant use, there is no shortage in supply. Local groups like the Franklin Park Coalition use community volunteers to beautify the park in which the zoo resides. They were very helpful in coordinating their cutting services when eradicating Japanese knotweed in the area.

**The Challenge of Year-round Access**

Being a zoo in northern North America, providing year round browse was another challenge to be

overcome. Shipping from out of state was rejected as too costly for the amount the animals needed on a daily basis. Zoo staff then investigated the idea of freezing browse during the growing season for winter consumption. Previous methods employed at other zoos were explored through listservs and personal communications.

### **The Need for Freeze**

In order to store vast amounts of browse, the zoo purchased a walk in cooler/ freezer to supplement space available in the zoo commissary freezer. Details of the unit are listed at the end of this paper.

### ***Freezing methods / choices***

Through trial and error the following methods were chosen as best suiting our needs:

#### Using full branches

Full branches are preferable over loose leaves for a variety of reasons including:

- Full branches are more easily bundled;
- Can hang them up easily when thawed out by tying together with twine, whereas loose leaves could not be harnessed as well.
- Eating off branches would also encourage more salivation, also thought to promote a healthy rumen.
- Giraffes have the opportunity to chew bark as well.
- In the past when only leaves were frozen they too often wilted and got slimy. The giraffes were less inclined to consume 100% that was offered
- Time is saved by not having to pluck off leaves and throw them into freezable bags.

#### Making bundles

The size of the bundle may vary depending upon species of flora used (i.e. Witch hazel bundles are different in morphology than those of grapevine) or the intended hanging area. Basic guidelines are as follows:

- Bundles are made using simple baling twine collected from hay and straw throughout the year.
- Make size of branches small enough to fit into standard sized 55-gallon plastic trash bag (trash bags have been found to store/freeze browse very well and are easy to come by in the zoo setting)
- Branches of a given species should be cut approximately the same size
- Make circumference of branch ends as large as can be manageable (typically the size of a one-handed grip); too large may lead to uneven freezing; too small and there will not be enough leaves per serving
- Eyeball an approximately equal amount of leaves per bag for all species so that all bundles, no matter what the species, is about the same size serving.
- Try to spread the bundles as flat as possible. Layering the branches all in the same direction aids in this. This makes easier stacking and more efficient use of storage space.

#### Moisture and air

Our protocol calls for a light misting of water from a garden hose on both sides of the bundle to aid in the freezing process. Too much water and the browse may either get freezer burn or when thawing out the leaves are more likely to wilt. Too little water and leaves are more brittle when thawed.

Once in the plastic bag, we try to limit the amount of air that the browse is exposed to while in the freezer. As with freezing anything organic, limiting oxygen will slow down decay of the plants and will lead to a fresher looking/smelling/tasting bundle. After squeezing out the air, plastic bags are tied around the browse, leaving the bundled ends outside of the bag. Mark bags with tape with the name of the species written on it. You will avoid exposing browse to the air just to check what you're feeding.

#### Thawing

Once removed from the freezer, bundles are spread out, still in their plastic bags, in our 71°F [-21.7°C] barn. After at least three hours, in time for pm feeding, bundles are removed from bags and immediately fed out.



Giraffes have eaten the leaves without first thawing. However, the frozen leaves are more fragile, sometimes have ice crystals on them and are likely to fall off the branch before it can be consumed.

### Which species?

The zoo has a list of browsable flora. The species we have had success with both freezing and feeding out are those listed in Figure 2. It is recommended to test varieties of species on your animals in the summer when it's fresh. If it is reliably consumed then those are the species you want to try to freeze. You can also try freezing in the summer to test your methods.

### Freezer temperature

Our freestanding supplemental freezer runs at just below 20°F [-6.66°C]. Our commissary freezer is kept below 10°F [-12.22°C]. Both have frozen browse adequately. However, special care must be taken to conserve the low temperature in the freestanding unit in order to avoid inducing an early thaw and refreeze. We have installed freezer flaps that help insulate it and enforced rules of limiting the frequency and amount of time the freezer door is open.

## **Recordkeeping**

### Keep track of what you're collecting

Avoid collecting too much or too little of certain species. Some species have been shown to have a 100% success rate with both freezing and feeding out, so getting a solid base of those are essential (i.e. Knotweed, beech, grapevine). Not every giraffe will eat 100% of every species so it's best to get a variety of species for the pickier eaters on the list. Also, adding occasional variety will hopefully prevent animals from getting bored with any one species. We have also found that browse freezes differently depending on species (i.e. Forsythia become more brown than others, and Mulberry is more likely to become wilted), so it's important to know what stays palatable and preferred.

Lastly look at your browse sources and take care not to deplete the source. It's to your advantage to read up on proper trimming of trees and bushes to encourage more growth for the next season.

### Record how each species was eaten – see Table 1

- Keeping a record of palatability will help in subsequent years to refine your browse freezing plan
- Record any anomalies - The "comments section" of both freezing and feeding out logs will help you learn what works well from year to year. Knowing how much you start with will help you pace out your feeding. Simple math gets you through the winter. Some animals do well receiving browse two or three times weekly. Our male, considering his condition, receives one to five bundles daily throughout the winter months.

## **Thinking in the long-term**

Once you discover the best methods that work for you, it becomes easier to think and plan ahead for the near and far future.

- Assign one or two people to supervise browse freezing to promote consistency in technique
- Bundling up to 500 bags takes a lot of string. Remember to save twine throughout the year. We collected what came on our hay bales.
- Always keep an eye out for new browsable species and test their palatability with the animals during the growing season. Take every opportunity to increase your resources.
- Plant more palatable species on institution property to facilitate access.
- Seek opportunities to involve volunteers, local businesses or community growers. Involving others can be an educational opportunity. This helps public learn about our professional level of care.

Zoo New England has used this browse freezing method for over seven years. While providing daily browse does not necessarily guarantee perfect giraffe health, its role in giraffe digestive health is becoming more accepted among nutritionist and other zoo professionals. Beau giraffe's condition has greatly improved. Where in his worst condition he was a thin 773kg four-year-old, we look at this 1280kg, robust 12-year-old now with three offspring and marvel at his (and our) success.

Date	Browse	Bundles	Total	Location	Storage	KW	262
28-Jun-10	Knotweed (KW)	67		Pearl's Lot	Commissary (C)-88	Russian Olive	3
	Cottonwood	18	85			Mulberry	64
	Sugar Maple	3	88			Forsythia	30
2-Jul-10	KW	72	160	Pearls Lot	C-84	Beech	34
	Cottonwood	12	172			Grapevine	46
3-Jul-10	KW	56	228	Pearl's Lot	C-59	Cottonwood	33
	Cottonwood	3	231			Sugar Maple	30
7-Jul-10	KW	18	249	Morton St	C-18	P. Willow	90
8-Jul-10	KW	34	283	Morton St	C-34	Bamboo	20
14-Jul-10	KW	11	294	White Stadium	C-25	Stag. Sumac	30
	Grapevine	14	308				
22-Jul-10	Beech	18	326	Beech Grove	C-18		
26-Jul-10	Sugar Maple	27	353	Nikki's house	C-27		
28-Jul-10	Mulberry	15	368	Compound	C-64		
	Russian Olive	3	371				
	Forsythia	7	378				
	P. Willow	39	417				
31-Jul-10	Mulberry	10	427	Building 3 Yd	C-18		
	Forsythia	8	435				
2-Aug-10	P. Willow	39	474	Compound	C-39		
3-Aug-10	P. Willow	12	486	Compound	C-32		
	KW	4	490				
	Mulberry	16	506				
7-Aug-10	Grapevine	30	536	Stadium	C-50		
	Bamboo	20	556				
8-Aug-10	Mulberry	23	579	Compound	C-23		
16-Sep-10	Staghorn Sumac	6	585	Squash Garden	(G)-6		
26-Sep-10	Staghorn Sumac	15	600	Morton St	G-17		
	Grapevine	2	602				
17-Oct-10	Forsythia	10	612	Ainu's yard	G-19		
	Staghorn Sumac	9	621				
22-Oct-10	Forsythia	5	626	Donation	G-5		
30-Oct-10	Beech	11	637	Golf Beeches	G-11		
1-Nov-10	Beech	5	642	Golf Beeches	G-5		
						<b>Commissary Freezer Total</b>	<b>Giraffe Freezer Total</b>
						579	63

**Table 1. Browse Collection Record 2010**

Other institutions may consider the freezing method to improve or promote the health of browsing ruminants, especially giraffes. With hope, these guidelines can help others develop a plan to meet their animal nutrition needs.

### Products Mentioned in the Text

Karo® syrup – ACH food company; [www.achfood.com](http://www.achfood.com)

Outdoor walk-in refrigerator/freezer – International Cold Storage;

<http://www.icsco.com/pdf/odspeccs.pdf>

Mazuri® Wild Herbivore Hi Fiber 5ZF1; [www.mazuri.com](http://www.mazuri.com)

Megalac® Rumen bypass product – Distributed by Pestell Minerals & Ingredients

Min-a-vite® Vitamin Supplement; Riche Laboratories, Inc

TUMS® – GlaxoSmithKline; [www.tums.com](http://www.tums.com)

Zoo Herbivore Pellets – produced for Zoo New England by Blue Seal Feeds; [www.blueseal.com](http://www.blueseal.com)

### Acknowledgements

Pearl and Sarah would like to thank and celebrate the capabilities of all Hooves and Horns staff involved in these achievements. Thanks to ZNE Animal Management for supporting the production of this document and to Dr. Eric Baitchman, DVM for his assistance.





By Wendy Shaffstall<sup>1</sup> and Adam Felts<sup>2</sup>  
*International Rhino Keeper Association Board of Directors*

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A planned and implemented enrichment program can contribute to better health by providing animals opportunities to exert some form of control over their environment [Baser, J., 1998; Carlstead & Shepherdson, 1994]. As it pertains to captive rhinos, we

strive to encourage species-specific behaviors in rhinos while providing them response options to environmental change. This will ultimately result in their mental stimulation and the development of naturalistic behaviors [McIntyre and Coers, unk; Swaisgood and Shepherdson, 2005].

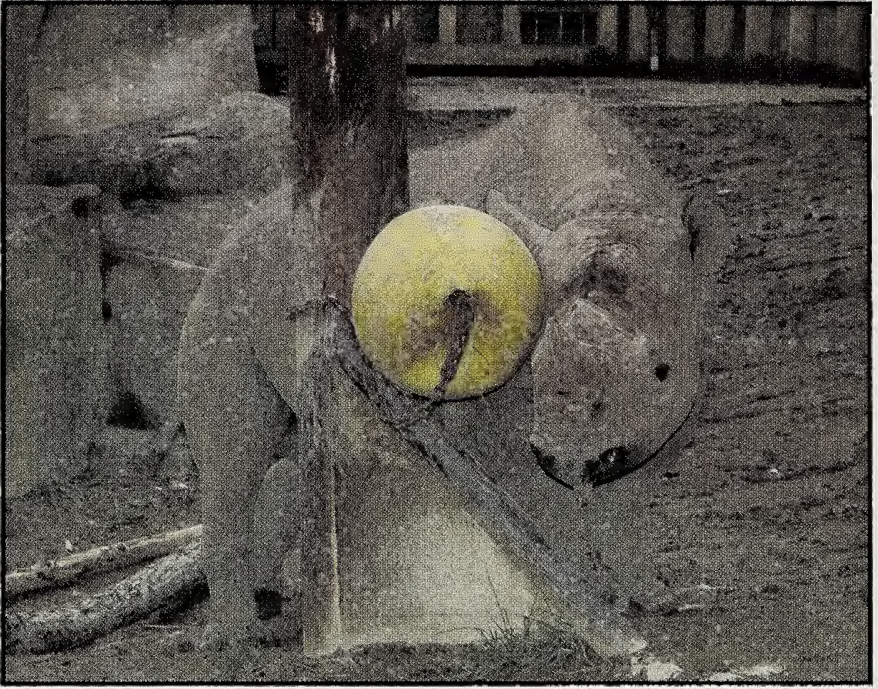
Each institution may have its own set of goals and criteria for the program, but fundamentally, you should start with an examination of the animal's natural history, activity patterns and behaviors seen in the wild, for example, demonstrating the use of black rhino prehensile lip by providing manipulative devices on exhibit for enrichment. Since rhinos spend the majority of their day eating we could look at modifying our feeding schedule or providing enrichment throughout the day rather than just once a day. We could also investigate the possibility of changing herd dynamics (or composition) with some species.

Holding facilities, exhibit spaces and/or any constraints that may be unique to your facility should be examined since these areas will directly impact your options for enrichment. The temperament and behavior of the specific individual(s) also needs to be taken into consideration. Once these criteria have been reviewed, a set of goals can be established. Generally speaking your primary goal should be to "promote opportunities for the expression of species-appropriate behaviors" [Joseph and Sevenich, 1999]. The Rhinoceros Husbandry Resource Manual [1996] clearly delineated the various functions enrichment can serve, such as (1) improving the well-being of the animal by increasing exercise, satisfying behavioral needs, and optimizing the level of stimulation that animals receive (2) educating zoo visitors by increasing the levels of natural and interesting behaviors, visibility and activity levels and (3) conserving endangered species by improving the success of captive breeding and reintroduction programs. This can be as simple as providing a wallow for mud bathing to complex environmental manipulation. The second goal of enrichment can be loosely defined as creating mental stimulation for the animal(s).

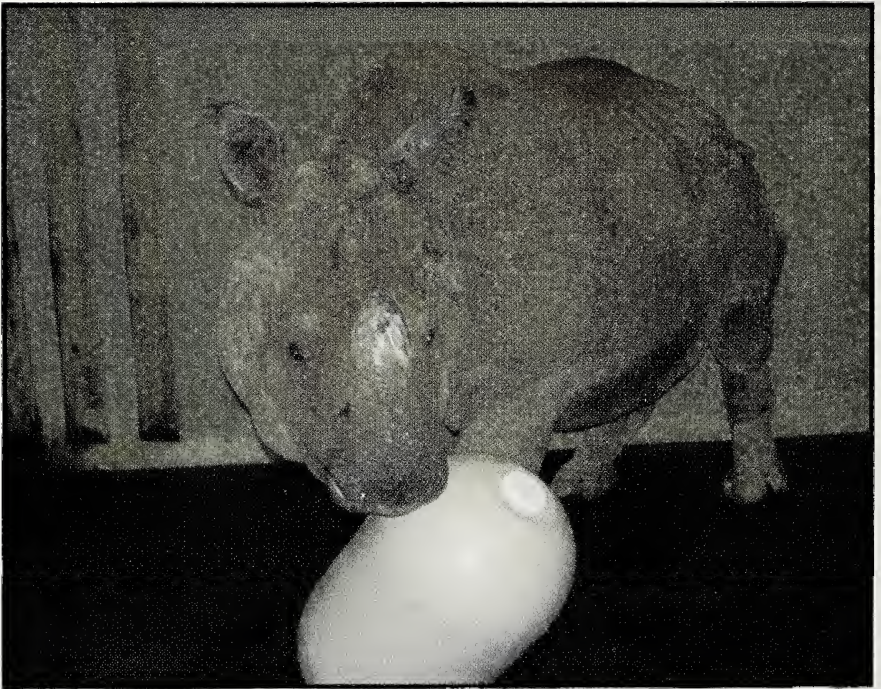
A successful enrichment program can be briefly summarized as:

- a) Establish goals for the program
- b) Create an enrichment approval form
  - State the purpose/goal of this enrichment
  - Provide detailed description of item (construction material, thickness, dimensions, size of holes, etc.)
  - Identify and address any facility or exhibit constraints that may be impacted
  - Identify and address any safety concerns
  - Cost estimates
- c) Identify approval protocol for enrichment submissions
- d) Create enrichment calendar (monthly or weekly) to ensure implementation schedule
- e) Determine how staff will document and/or track animal response to enrichment offered.





Creativity can be used to fabricate a unique device to suit your enrichment needs.  
(Photo: Adam Felts)



Some enrichment devices are manufactured for rhinos and other species that require additional strength and durability. (Photo: Wendy Shaffstall)



To accomplish the goals mentioned above, your plan should be tailored with a set of criteria for either the individual or the species in general. Your final proposal should then be submitted through the appropriate channels for approval. Ideally, an enrichment approval system should be set up to allow Keepers, Managers, and Veterinarians the ability to assess the proposed enrichment and approve/reject it. Institutions can alter their enrichment scheduling as well as vary the type of enrichment offered (ex: toy, food, sensory, environmental, behavioral and social) and keep track through their record-keeping or on a barn calendar [Connett, 2009]. One of the most intimidating aspects of enrichment is allocating the time to document animal behavior and/or responses to the enrichment offered, however, observations of responses can either be done in a direct, or indirect, manner as time allows. This data will enable you to evaluate if the enrichment goals have been met. Since enrichment is dynamic in nature, if you haven't reached your goal, you can make the necessary adjustments and be able to offer the most effective enrichment to the animal(s).

Enrichment can correlate aspects of ethology, psychology and animal husbandry to create a more stimulating environment for the animal [Mellen and Ellis, 1996]. This has led to the inclusion of enrichment options being incorporated into exhibit designs. Exhibit enrichment can be done by varying topography, landscaping, utilizing deadfall and trees, creating dirt mounds, planting vegetation, providing a wallow, and alternating the substrate (dirt, leaf litter, mulch, etc.). Other options (public view versus privacy, shaded area versus sun, etc.) can all provide the animal some control over their environment and make choices throughout the day. The aforementioned exhibit variables can contribute to an effective means of enrichment, especially when it can be used in conjunction with other approved enrichment. For instance, novel scents/perfumes/extracts can be used to create a "trail" throughout the exhibit, while holes drilled in deadfall can serve as an anchoring point for browse and either one can provide the potential for exploration and create options for the animal. The American Association of Zoo Keepers (AAZK) has created The Enrichment Notebook [2004] which provides suggested guidelines and contains information on exhibit enrichment, dietary enrichment and a section on safety considerations. Bear in mind that when you are using enrichment devices that are awkward and heavy, it is important to secure these items safely not only for the animals, but keeper staff as well. Fortunately, with the help of your maintenance team, these somewhat bulky items can be secured safely by using pulley systems and/or other equipment can be used to hoist devices to enable you to hang them higher. A synopsis of rhino enrichment options that are currently being used at zoological facilities can be found in Table 1. This table gives suggestions as to the primary area of use as well as its presentation. Some examples of enrichment type, and some options that can be used, are outlined below:

#### **Toy:**

- ◆ Boomer Ball®
- ◆ Weeble®
- ◆ Suspended log

#### **Food:**

- ◆ Scatter food around exhibit to stimulate grazing/foraging
- ◆ Place food items in enrichment devices to be randomly dispensed
- ◆ Fruits and vegetables frozen in bucket of water

#### **Sensory:**

- ◆ Use conspecific's dung for smell (olfaction)
- ◆ Play different animal vocalizations or hang bamboo "chimes" for hearing (audition)
- ◆ Mount street sweeper brush for touch (tactition)

#### **Environmental:**

- ◆ Changing substrate (leaf litter, dirt, mulch, etc.)
- ◆ Altering daily routine
- ◆ Rotating to different enclosure (pen)

### **Behavioral:**

- ◆ Training new behaviors
- ◆ Training for veterinary procedures

### **Social:**

- ◆ Creating mixed-species exhibit
- ◆ Rotating individuals (add or remove animals when possible)

Any ideas garnered from this table or list of options must be used in compliance with a facility's enrichment protocol, regulations and safety considerations.

We cannot overlook the fact that training for husbandry behaviors is not only stimulating for the animal, but can provide an invaluable opportunity for the veterinarian to perform diagnostic procedures with potentially less stress and more cooperation from the animal(s) [Dover, et al., 1994]. The chapter for training will delve more in-depth into this topic, but authors wanted to stress the enrichment aspect of the training process.

*The authors would like to express their sincere thanks to their colleagues on the International Rhino Keeper Association Board of Directors who graciously agreed to help revise and edit the rough draft. And they would also like to acknowledge the rhino keepers who submitted their enrichment suggestions via e-mail or through completing Rhino Keeper Workshop membership surveys.*

*This has been re-printed from the upcoming Rhinoceros Husbandry Manual (anticipated release in 2011) with permission from Editor, Adam Eyers and Rhino Advisory Group Committee Members, Steve Schurter and Randy Reiches.*

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**Table 1.** Synopsis of rhinoceros enrichment ideas

Enrichment option	Primary area of use:		Presentation:	
	on exhibit	holding area	suspended	ground
55 gallon plastic drum		X	X	X
"Amazing graze" (with biscuits, horse treats or produce inside)	X	X		X
Audio clips of rhino vocalizations or other species' vocalizations		X	X	
Beer kegs		X	X	X
Biscuits (gorilla sized leaf eater, apple and oat horse treats)	X	X		X
Boat mooring buoy		X	X	
Boomer balls	X	X	X	X
Bowling balls		X		X
Branch/twig with produce pieces skewered on it	X	X	X	X
Browse or approved plants	X	X	X	X
Brushes	X	X	X	
Brushing by keeper		X		
Cardboard boxes (with produce and without)		X		X
Firehose "wall"		X	X	
Frozen ice blocks (flavored/non-flavored, produce/without produce)	X	X		X
Large cardboard tubes		X		X
Logs, stumps, rootballs	X	X	X	X
Melons (whole or chunks)	X	X		X
Mirrors		X	X	
Misters	X	X	X	
Mud wallow	X	X		
Non-radial tire (with cuts in sidewall for safety)		X	X	
Oblong stone	X	X		X
"Painting" with non-toxic finger paint		X		
Paper grain bags filled with hay and/or produce		X	X	X
Paper mache balls	X	X	X	X
Peanut butter (on "furniture", toys, walls, etc)	X	X		
Planter buckets	X	X	X	X
Plastic carbonated beverage concentrate container		X	X	X
Plastic ice blocks and/or iceberg toys		X		X
Plastic jug feeder		X	X	
Pool	X	X		
Produce (can be used in a variety of means or in devices)	X	X	X	X
PVC tube with bells suspended inside		X	X	
PVC/Bamboo "chimes"		X	X	
Rolling treat buckets/feeders (with biscuits, produce and/or horse treats inside)		X		X
Scents, flavorings and/or extracts	X	X		X
Snow pile, snowpeople (with and without fruit mix sprinkled on them)		X		X
Substrate piles or rotation (dirt, gravel, sand, leaf litter)	X	X		
Traffic cone and/or pylon		X	X	
Training with keeper	X	X		
Triangle rattles		X	X	
Urine, feces, soiled bedding from other species or conspecifics	X	X		X
Weeble	X	X		X
Weeto	X	X		X

**Primary area of use** may be dictated by institution's guidelines and criteria.

**Presentation** format is the one that was most commonly cited as being used.



# Managing a Research Population of an Extremely Flighty Ungulate Species at SCBI

*By Dolores Reed, Mammal Keeper/Hoofstock, Center for Species Survival  
Smithsonian Conservation Biology Institute, Front Royal, VA*

Eld's Deer or Burmese Brow-antlered Deer (*Rucervus eldi thamin*) are by nature a very nervous and self-destructive species in captive settings. They are exceedingly difficult to display successfully on exhibit. Attempting to hand-raise fawns to make them more tractable can cause problems of its own particularly with males that can become extremely aggressive when in rut.

The Smithsonian's Conservation Biology Institute (SCBI) has a long history with Eld's deer going back to the late 1970's. To date, 158 fawns have been raised at SCBI and 37 of those fawns were added to the collection from Smithsonian's National Zoo exhibit animals. Three fawns were the result of laparoscopic artificial insemination and one fawn resulted from a standing non sedated trans-cervical artificial insemination. Currently 20 female and five male Eld's deer reside at SCBI, the majority of which are mother-raised.

Initially the deer were housed in heavily wooded large yards and paired for breeding purposes only. They were extremely secretive and ran whenever they saw a human. They were generally only handled for neonate exams just after birth. Self inflicted injury and mortality was high in both fawns and adults during necessary manipulations due to their flighty nature.

In the early 1980's several fawns were pulled for hand-rearing in a new research barn (Rivinus Barn). It was observed that just because they were hand raised still did not make them calm but definitely took the edge off of their extremely flighty tendencies. From these first hand-reared youngsters the management of this species has advanced by leaps and bounds. Self-inflicted injuries are a rarity and management related mortality has occurred on just one occasion in the last 10 years. Intensive hands-on management has become the norm. It is paramount in any extremely flighty species to start early, preferably in infancy, and keep them in consistent close contact. This includes confinement and separation from co-specifics if necessary until the appropriate level of manageability is attained. The benefits to safe husbandry, research and veterinary manipulations are greatly enhanced.

The research at SCBI continues today. All Eld's deer are now mother-raised unless medical needs necessitate hand-rearing. The mother-raised animals are more attuned to normal herd behaviors

and the males are less of a keeper safety risk. The Eld's deer are routinely weighed, trailer loaded, vaccinated, subjected to ultrasound exams, bled, inseminated and, yes, even catheterized without chemical restraint. All of these procedures can be performed using minimal physical restraint. To keep succeeding generations tractable, desensitization and training are begun very early (Figure 1). Each

fawn is extensively handled at its dam's side. It is weighed and handled daily for the first 30 days of its life. While in the scale stall, a fawn is briefly held with one arm around its hind quarters and the other around its chest until the fawn begins to relax. Once the fawn is relaxed for a few seconds, it is released from the restraint (Figure



Fig. 2. Restrained fawn  
(Photo: Meghan Murphy,  
Smithsonian's National Zoo)



Fig.1. Eld's deer fawn on scale  
(Photo: Meghan Murphy,  
Smithsonian's National Zoo)



2). The key idea here is that the fawn is not expected to like the restraint but be willing to tolerate it. Some fawns take longer than others to become tolerant. Novel persons are introduced to the fawns whenever possible. After the first 30 days the fawns are weighed and handled once weekly and their living quarters continue to be entered daily. It is an ongoing routine that must be maintained or true to their nature the deer will revert to a more wild state and do so rather quickly. The fawns are progressively given more room to roam with their dams, beginning with the center of the barn aisle at approximately four weeks of age for several hours a day (Figure 3). The dams and fawns graduate to a small outside yard at ~ two months and progressively larger yards a month at a time thereafter, if they continue to stay tolerant and tractable. Mothers and fawns are confined back into stalls every evening (Figures 4 & 5 ).



Fig. 3. Center aisle of annex facility.  
(Photo: Dolores Reed, SCBI)

To move both the adult males and females through chutes, aisles, etc. basic body language is used. To move an animal from one place to another through a chute, a familiar keeper can either call them, or gently push them. If the deer is reluctant to come they can be pushed by facing the animal and making direct eye contact. This is a signal to the deer that the keeper wants them to move away down the chute, aisle etc. If a keeper stands facing to the side with shoulder or back directed at animal, without making direct eye contact, it is a signal to the deer that they can pass by the

keeper and the keeper has no interest in them. With a familiar keeper a frightful deer will frequently seek protection/security from this keeper and may choose to stay close. It is essential to stay calm and move with determination and consistency. The deer can very quickly detect when the keeper is uncertain and hesitant, which in turn makes them unsure and distrustful of the keeper's intentions. It is imperative that the deer have a familiar person with them during new and unfamiliar situations. SCBI barn management explicitly states that no access to the facility be permitted to anyone without the area keeper's notification.



Fig. 4. Eld'sdeer in small outdoor yard  
(Photo: Dolores Reed, SCBI)



Fig. 5. Stall set-up for mother and fawn  
(Photo: Dolores Reed, SCBI)



The research facility itself is a very important component of our successful management practices. A second barn was built to support reproductive research primarily to keep males and females separated. As with many other ungulate species, when the females are kept near the males during the breeding season the male's rutting behavior is intensified which can cause the males to become exceedingly difficult to manage, in some instances to the point of self-mutilation.

The male barn is comprised of individual stalls each with an outside area separated by solid sheet metal to avoid fighting between males when in rut. Each male is individually housed while in hard antler. Adult male deer are generally physically handled twice a year. A few days after each male sheds its antlers he is moved through the central barn aisle to a scale stall where he is weighed and physically restrained for annual vaccinations, blood draws, etc. The physical restraint involves one person standing facing the male at his shoulder with one leg pressed in front of animal's chest and the other leg behind the deer's front leg. A second person is positioned facing the deer at the hind quarters with one leg pressed into the abdomen in front of the deer's hind leg and one behind its rump to keep the deer from backing out of the hold. The deer is pressed against the wall of the stall with slight upward pressure. There is no downward pressure applied during the restraint, since applying downward pressure causes the animal to push back gaining leverage from the ground with its powerful jumping legs.

Once weighing and other procedures are completed, each male is turned out to pasture (3-4 acres in size) with any other males that may have already shed antlers. While the male deer are out on pasture, keepers interact with them directly drawing them into the barn daily for feeding and visual exam. On rare occasions a male may show aggressive tendencies such as dropping his head, strutting, or hissing. These behaviors are more frequently displayed at new keepers and volunteers. The aggressive behaviors are discouraged and immediately countered with a raise of the hand and a change in tone of voice from the keeper/volunteer. If the advance does not stop, a move is made to touch/poke the male on the hind quarters which causes him to pivot away from the keeper to protect his hind quarters. This usually diffuses the situation. New keepers/volunteers are always accompanied by a familiar keeper until the deer have become comfortable with the new person. The male deer are handled/weighed a second time just prior to stripping velvet when they are brought in off pasture and moved into individual stalls and runs for the rutting season. Again, the same restraint procedure is used as described above, if needed, with extra care taken not to touch or damage the antlers still in velvet.



Fig. 6. Male with giant Jolly Ball®

(Photo: Dolores Reed, SCBI)

The male deer can be particularly hard on the facility during rut. Giant sized Jolly Balls® were introduced to the males several years ago as an enrichment item (Figure 6). These balls have really helped reduce wear and tear to the physical facility. Smaller Jolly Balls® are offered to the younger, smaller racked males to avoid antler breakage.

The female facility is connected to the male facility by a chute system. This barn (Rivinus Annex) has its own internal chute system that runs around 20 individual stalls and incorporates a scale stall. Females are housed together in a herd year-round unless they are with fawns, in which case they are separated within the barn until fawns are old enough to fend for themselves within the herd hierarchy. Fawn introductions usually occur around seven months of age. The adult females are weighed several times a year. All other procedures are also performed with them while they are in the barn's scale stall. (Figure 7)





Fig. 7. Three-month-old fawns in scale stall. (Photo: Dolores Reed, SCBI)

The female deer are restrained much more frequently than the males. Examples of procedures performed with female deer in the scale stall include:

- Blood draws, fluid therapies, vaccinations, ear tagging, milking, induction of sedation.
- Loading and unloading from horse trailer for procedures at veterinary hospital.
- Estrus synchronization (injections and CIDR device implantations) for subsequent super ovulation for laparoscopic egg retrieval or laparoscopic artificial insemination.
- Standing trans-cervical artificial insemination without sedation.
- Trans-abdominal ultrasound to detect and track pregnancies, including in-utero fetal manipulations due to malpresentations-breech, etc. (Figure 8)

Fig. 8. Ultrasound to monitor pregnancy in scale stall. (Photo: Meghan Murphy, Smithsonian's National Zoo)



Despite all the care and training taken in Eld's deer desensitization they can and still do occasionally "fall apart". Great care is taken to have a keeper they are familiar with by their side during any maintenance work or other novel activity around the barns. Each barn also has a radio playing softly at all times to help keep the deer familiar with different tones/pitches of the human voice. The radio can be turned up to help muffle unfamiliar sounds such as power equipment or heavy machinery that may be needed to be used in close proximity for facility maintenance, repairs, upgrades, etc.

In summary, due to the flighty nature of Eld's deer, constant interaction to keep them tractable is necessary. They need to be worked with early and often, and kept in close human contact on a frequent basis with calm, patient, and familiar keepers for a safe and successful management program. The SCBI Rivinus and Annex Barn facilities have also been successfully utilized on a limited basis with adult Scimitar-horned Oryx (*Oryx dammah*), Przewalski's horses [*Equus ferus przewalskii*], Sable antelope [*Hippotragus niger*] and Tufted deer [*Elaphodus cephalophus*]. The SCBI's Annex facility design has been successfully incorporated into reproductive research programs in the Eld's deer range country of Thailand as well. I am confident this management technique can successfully be used with numerous other flighty ungulate species, with a measure of patience and time.

# Hoof Management of Hartmann's Mountain Zebra at Disney's Animal Kingdom Lodge

By Vickie Shaw, Animal Keeper  
Disney's Animal Kingdom Lodge®, Lake Buena Vista, FL

Hartmann's mountain zebra (*Equus zebra hartmannae*) is a threatened species found in the mountainous regions of Namibia and South Africa (Estes, 1991). This species has adapted to living in a harsh and mountainous habitat and so its hoof structure has evolved to meet those needs. The Hartmann's mountain zebra have fast growing and unusually high angled hooves that have sometimes proven a challenge for long-term management. In 2007 the Hartmann's mountain zebra was chosen as a flagship species for Disney's Animal Kingdom Lodge (DAK Lodge) for its unique stripe pattern and dewlap, its threatened conservation status and its ability to mix well in exhibits with other ungulate species. The current herd of 1.5 Hartmann's mountain zebra at DAK Lodge is exhibited with six other hoofstock species (roan, eland, giraffe, wildebeest, ankole cattle, and blesbok) and three avian species (ostrich, marabou storks, and East African crowned cranes) on an 18-acre savanna.



Hartmann's mountain zebra on the Sunset Savanna (Photo: Disney's Animal Kingdom)

The animal management program at the DAK Lodge is different than many traditional zoological facilities. At DAK Lodge the guests staying in hotel rooms and suites have a view of the animal collection and the savannas from their balconies. The animal collection remains out on the savanna overnight and they are audio cue trained to respond to enter the barn for approximately two hours in the morning where their grain diet is given. While secured in the barns, the savannas are cleaned and the avian species are tended to. It is in the barn that husbandry training is directed to species that need attention. A common husbandry concern for equid species is hoof maintenance. The native habitat for Hartmann's mountain zebra is hard soil, rocky, and a dry climate. DAK Lodge is substantially different from their natural habitat in that their DAK Lodge exhibit is mostly flat, very humid, and has sandy soil.



This is an example of how aggressive trimming is needed to clear away damaged laminae due to whiteline disease.

(Photo: Vickie Shaw)

In 2008 the animal care staff noticed the start of several hoof conditions (over grown hooves, white line disease/fungal infections, and hoof abscesses) in our herd. An aggressive hoof trimming and photo documentation protocol was started to help correct these issues. The domestic horse grows about one-fourth to one-half inches of hoof wall per month. On a domestic horse this type of hoof growth would mean hoof trims at about every six to eight weeks (Hill, Klimesh, 2009). This frequency of trimming is generally not possible in a zoo setting as it is not practical to immobilize a zebra that often just trim their hooves. At DAK Lodge we immobilize each



of our 1.5 Hartmann's mountain zebra every three to four months to address hoof growth issues. Institutions that house this species on rocky exhibits or on open range exhibits seem to be able to lengthen their trimming to yearly or even every two years (depending on the individual). Each individual zebra has different hoof issues, but DAK Lodge's entire herd at some point have all had white line disease. White line disease is a breakdown of the laminae in the white line region of the hoof by bacteria, yeast or fungus. If living in soft substrate areas, aggressive trimming several times a year seems to be what this species needs to keep their hooves in shape. Even when a lot of hoof is taken off, we have not seen any lameness in the herd post-immobilization.

To address the issue of the white line disease in several of the herd members, the veterinary staff suggested a treatment of hoof soaking in Dakin's solution. Dakin's solution is a 1:10 mixture of Sodium hypochlorite per liter of water with a one-half teaspoon of baking soda per liter of water that is placed in a commercial hoof soaking tray. The hoof soaking tray measures 72 in. long x 36 in. wide x 15 in. deep. A training program was started to acclimate the herd to a soaking tray placed in a hallway of the barn. Their diet and a variety of novel food items were used as rewards for the zebra standing in the tray for the allotted soaking time of 10-20 minutes. Hoof soaking is done on a three-week rotation for each zebra. The combination of aggressive trimming and the trained behavior of hoof soaking have helped us maintained better hoof health in the Hartmann's mountain zebra herd at DAK Lodge.

Hartmann's have not been exhibited much in the United States in recent years. Due to their fast growing hooves, this species does require close attention to their hooves. But with aggressive trimming the frequency of trims can be decreased. With the help of husbandry training, issues like long-term hoof maintenance can be addressed. Zebra are a huge draw to most exhibits, and Hartmann's are a species that are a wonderful addition to most exhibits.



This photo is taken in an off-show area where hoof soaking is trained. (Photo: Vickie Shaw)

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# Moving Onward and Upward: Building a Contemporary Giraffe Facility

*By Amber Eagleson, Area Manager- African Journey  
Fort Wayne Children's Zoo, Fort Wayne, IN*

In 2007, management at the Fort Wayne Children's Zoo (FWCZ) decided to face the impending reality that our current giraffe barn soon would not be adequate to serve our institution's needs. With our steadily increasing giraffe herd, coupled with our desires to participate in population sustainability, we started the process of crafting a giraffe facility that would accommodate the needs of the institution as well as the individual animals. After traveling to various institutions and discussing the wants and needs of the keepers themselves, we determined that we wanted our facility to reflect the one located at the Jacksonville Zoo in Jacksonville, FL. This design showcased a penning system, adjustable hay racks and a Tamer®, all designed and manufactured by Fauna Research. This would enable us to advance our techniques in medical husbandry, and do so while keeping the facility keeper-friendly.

Within the last decade the giraffe herd at the FWCZ has almost doubled in size. The herd has grown from four giraffe to seven giraffe, with an eighth due to arrive in six months. We needed a facility that would allow us to continuously expand our herd while keeping the giraffes comfortable. Initially, our giraffe facility was shaped as a giant square that consisted of two stalls in the front and two stalls in the back. It was difficult to access the back stalls and visibility was not good. Since there were only four stalls it was difficult to separate individuals out for a lengthy amount of time, such as for pregnancy or medical issues. Also, this set-up was difficult on our bull that was separated each night from the females. Since he was adjacent to the females it was frustrating for him when the females were in estrus. We wanted an enclosure that would adequately house our bull, but at the same time allow for distance between the male and females without compromising space.

It was important to us that we be able to accurately monitor the weights of our giraffes, something that was not possible with our outdated barn. We had a strong operant conditioning program, but keepers were still limited in what they could do merely because the configuration of the barn did not allow the keepers to safely access many body parts of the giraffe. The FWCZ has a strict protected contact policy, so keepers are always required to have a barrier between them and the giraffe. This made hoof work, as well as blood draws, extremely difficult. Keepers created a window in the wall dividing two pens near the ground and were able to condition the giraffes to place their front hooves on the ledge, but it was almost impossible to safely access the back hooves. There was an attic with a window leading into the giraffe stalls that put the keeper at eye level with the giraffes, but it was difficult to train for blood draws and still adequately reinforce the individual. It was a small window that accommodated only one person at a time. We felt that a Tamer® would be extremely beneficial for our operant conditioning program and also provide the means necessary to give our giraffes the optimal care they deserve.

The FWCZ has had great success with our giraffe breeding program. We are home to two high-ranking females and a high-ranking bull. We felt that more space would be beneficial and perhaps allow us to house two bulls in the future. One of our high-ranking females, Zahra, is the daughter of our bull. If we were able to accommodate two bulls, it would allow us to breed Zahra at our institution and give us more opportunity to expand our herd. We want to do everything we can to contribute to the genetic diversity of giraffe in the captive population. Obviously we could contribute much more with two breeding bulls. Also, it would give us the reassurance of being able to sustain the numbers of our own giraffe herd, especially since two of our females are over 20 years old.

After deciding that it was necessary to design a new giraffe holding area, staff began traveling



to other zoos to examine their giraffe facilities. Many had great aspects that we admired but we were extremely impressed with the accommodations at the Jacksonville Zoo. The facility there encompassed all of our objectives, including a state-of-the-art Tamer®. Fauna Research was the provider of the Tamer®, along with our facility's side paneling and hayracks.

The FWCZ began consulting with Fauna Research, and construction began in 2010. Our facility was complete after approximately eight months. The finished giraffe facility boasts a total of six stalls, two of which can serve as ideal birthing stalls or bull pens. Stalls are side-by-side, with the exception of two smaller stalls that are located back to back. See Figure 1 for the layout dimensions.



Fig. 1. View of Giraffe Facility  
(Photo: Amber Eagleson)

covered by plywood sheeting. See Figure 2 for a picture of a standard wall.

Two means of shifting animals were incorporated into this new facility. Fauna Research 4ft. wide x 12ft. high [ $\sim 1.22\text{m} \times 3.65\text{m}$ ] doors were installed between each pen. These doors are cable operated sliding roller doors that are manipulated by a crankshaft pulley system. See Figure 3 for a picture of a standard Fauna Research door. The wheels that control these pulleys are located in the keeper aisle ways found running along the south and east walls. In addition, a four-foot-wide transfer aisle way was included at the front of the stalls, which is another way the giraffes can be shifted between pens. The four-foot-wide transfer aisle also contains doors that separate each pen; all of these doors are manually operated. Having two different means of shifting animals is ideal because animals can bypass each other without actually crossing paths.



Fig. 2. Standard wall in new giraffe facility  
(Photo: Amber Eagleson)

To accommodate unloading and loading giraffes, a four-foot-wide Fauna Research door was installed on the east side of the transfer aisle adjacent to PEN F. When a trailer is backed up to this door, a giraffe can walk directly into the transfer aisle and from there keepers can utilize the doors to shift the giraffe accordingly. A giraffe being loaded into a trailer can be shifted into the transfer aisle and moved down the aisle by closing doors.

All doors that lead directly to the outside of the building are comprised of two doors. One is the Fauna Research door that acts as a “screen” door. The other is a heavy-duty solid wooden door. If



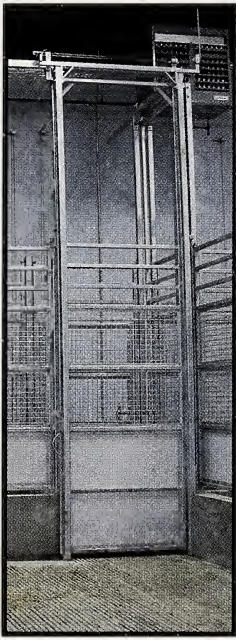


Fig. 3. Standard Fauna Research door. (Photo: Amber Eagleson)

will hinder the animal from leaving, as well as an emergency side exit door for the giraffe. There is also a neck yoke to help secure the head of the giraffe. Fauna Research offers a scale as an additional option, which we chose to purchase. The scale is built into the floor of the Tamer®. Please see Figure 4 for a picture of a standard Fauna Research giraffe Tamer®.



Fig. 4. Standard Tamer® (Photo: Courtesy of Fauna Research)



Fig. 5. Adjustable Feeder (Photo: Courtesy of Fauna Research)

Furthermore, we included adjustable feeders in the new facility. Each feeder, available through Fauna Research, is controlled by a pulley system with a winch that raises and lowers the feeder. These feeders have the capability of storing hay or grain and are adjustable in height. In this way we can designate the height of each feeder according to the size of the giraffe. This specific design allows the feeders to be safe for the giraffe even when adjusted at a low level, which is ideal for calves that cannot yet reach the normal height of a hay rack or food tub. See Figure 5 for a picture of an adjustable feeder.

Other amenities encompassed in our updated giraffe facility include grooved floors, which help wear down the hooves of each giraffe. The sizes of the grooves were custom designed by staff to maximize their effect. There were significant improvements to the hooves of our giraffe (which did not involve keeper training)

within the first few months of the giraffe residing in the new area. In addition, trench drains were added to each stall. These drains are very keeper-friendly in that they make hosing the stalls much, much easier. See Figure 6. To aid in hosing the stalls, booster pumps were installed at each hose hookup. High pressure nozzles are used on a daily basis to facilitate easier and faster cleaning. Since the floors are grooved the booster pumps and nozzles make it much easier to clean the floors, especially since it is difficult to rake up bedding and feces that falls deep in the grooves.



Overall, the design of the FWCZ's new giraffe barn has facilitated many improvements to the care of the giraffe herd. Keepers are now able to routinely weigh each giraffe and can now detect subtle changes in weights of each individual. Weighing regularly also helps us monitor the growth rate of the calves. With the benefit of the entire facility being novel to the giraffes, most of them became comfortable traveling in and out of the Tamer® fairly quickly. This has helped immensely with our operant conditioning program. Within months, two of our giraffes were conditioned to stand in the Tamer® (with the back door open!) and willingly participate in successful blood draws. Many individuals in the herd are accustomed to tactile contact from keepers via the side access panels. The majority of the herd will stand calmly in the Tamer® and accept reinforcement while both the front and back doors remain open. The Tamer® has served as a rewarding place for the giraffes and none have experienced negative encounters with it.



Fig. 6. View of grooved floors and trench drain  
(Photo: Amber Eagleson)



View of giraffe in separate stalls, but tactile contact still apparent. (Photo: Amber Eagleson)

Significant improvements have been made to the hooves of each animal due to the grooved floors and hoof work will continue to progress because keepers can now safely access the rear legs and hooves of each animal standing in the Tamer®. Since the new barn is four times larger than the old barn, we are now able to increase our herd without compromising space for the animals. We have agreed to house another bull this fall because we can now shift animals without having them cross paths (if need be). In addition, our bull can now be separated from the females overnight with ample space between them. The design of this new barn, along with the increased square footage, has been magnificent for not just the animals' well-being, but has

opened up a realm of possibilities for the keepers' operant conditioning programs with the giraffe. It is our hope that we can continue to enrich the lives of our giraffe and remain on the forefront in the AZA world of reticulated giraffe.



# NOTES FROM THE FIELD



**BLOOD DRAW**



*"The most trusted name  
in animal restraint."*



**MALE  
SITATUNGA**

**LOCATION:** ZSL WHIPSNAD ZOO, BEDFORDSHIRE, ENGLAND: HOOFSTOCK  
BARNs AND OFF-EXHIBIT AREAS

**SPECIES:** SITATUNGA, SCIMITAR HORNED ORYX, NILE LECHWE

**EQUIPMENT:** PORTABLE CAPTURE & MANAGEMENT PENS WITH A TAMER2,  
DIGITAL WEIGH SCALE, AND PUSHBOARD ALLEYWAY

**NOTES:** THE EQUIPMENT ARRIVED AT WHIPSNAD IN MAY 2010 AND WAS  
IMMEDIATELY PUT TO USE.

**DAY 1** THE TAMER 2 WAS SET UP OUTSIDE THE SITATUNGA BARN IN ABOUT  
3 HOURS. SIX ANIMALS WERE RESTRAINED, DEWORMED, WEIGHED, HAD  
BLOOD DRAWN AND A HOOF TRIM AND THEN WERE CRATED AND MOVED TO  
THEIR SUMMER EXHIBIT.

**DAY 2** A TAMER 2, WAS SETUP IN A QUARANTINE AREA IN ORDER TO TB TEST  
AND ADMINISTER A ROUTINE HEALTH EXAM TO SEVERAL ORYX.

**DAY 3 & 4** A PORTABLE TRAP CORRAL WITH MANAGEMENT PENS AND PORT-  
ABLE PUSH ALLEYWAY WERE SETUP TO CAPTURE AND SORT A HERD OF NILE  
LECHWE IN THE COMING WEEKS.

**DAY 5** RESTRAIN ORYX IN THE TAMER 2 TO READ TB TEST.



**PORTABLE  
ALLEYWAY**



**NILE LECHWE PORTABLE  
CATCH PEN**

For more information about TAMERS at this facility, contact:  
Mark MacNamara at (845) 758-2549, or e-mail: [faunaresearch@yahoo.com](mailto:faunaresearch@yahoo.com)  
[www.faunaresearch.com](http://www.faunaresearch.com).



# Creating New Tools to Reduce Fearful Behavior in Three Ungulate Species at the Oakland Zoo

*By Amy Phelps, Primary Giraffe Keeper, Keeper II  
Lisa Clifton-Bumpass, Volunteer Training Consultant  
Oakland Zoo, Oakland, CA*

The Oakland Zoo's African Veldt Exhibit team has successfully met the husbandry and training needs of the giraffe, eland, and gazelle by reaching outside the exotic animal care industry. When the staff was faced with training complex medical husbandry behaviors, keepers brought a domestic animal training consultant to the training team. Many training solutions were discovered through the integration of methodologies and training protocols from both domestic and exotic fields. These tools allowed animals with a low threshold for fear-flight-freeze responses to benefit from systematic processes of desensitization to novel stimuli. The science of applied behavior analysis gives exotic and domestic animal husbandry and training professionals several exacting tools to reduce the stress and fear-based responses of animals to novel objects and people.

The Oakland Zoo uses classical conditioning to change an animal's association with novelty from fear to operant interactions, often referred to as choice. A training construct known as "Stranger Danger" informs the training plan design, core skill assessment, reinforcement hierarchy, bridge selection, and team training processes. Key strategies in training these ungulates by shaping behavior are effectively applied to many other behavior management needs: measuring behavior, reinforcement choice, team building, micro shaping and the micro shaping strategy, reinforcement hierarchies and an adaptation of Karen Pryor's training game: "101 things to do with a box," allowing an animal to interact with new people and objects from the positive quadrant of behavior modification. Assessing the learning styles, rate of acquisition, and the social preferences of specific individuals within the Oakland giraffe, eland, and gazelle herds allow trainers to extrapolate the methods used within domestic animal behavior modification to benefit these animals. Dramatically reducing the fear-flight-freeze response facilitates the training of advanced and often invasive medical husbandry behaviors that can be accomplished in protected contact and entirely without the use of physical or chemical restraint of the animal.

The anatomy, physiology, and natural history of each ungulate species brings many unique challenges to their captive management. Their sheer size and species specific needs of giraffe complicate routine husbandry practices and anesthesia becomes extremely dangerous. With the tendency toward the flight response in the gazelle and the jumping abilities, overall powerful strength, and weight of the eland, darting procedures, anesthesia, and manual restraint can be dangerous, difficult and risky for animals and humans alike. In many zoological institutions, medical treatments are typically accomplished either by placing the animal inside a mechanical restraint or squeeze device, forcing the animal to comply by utilizing equipment such as movable wall or hallway panels, or by hand grabbing the smaller ungulates. Because of the historic physical risks involved in standing sedations and anesthesia with giraffe, and the risks and stress involved in force-based methods with the antelope species, the Oakland Zoo giraffe collection is currently managed by the practice and application of reinforcement-based training methods which allow the animal to willingly participate in many procedures without physical or chemical restraint.

All behavior management and routine husbandry care of the animals is anticipated and trained for by using the methods from the science of Behavior Analysis relying on the least invasive, and minimally aversive practices and procedures to create behavior change. This allows staff to anticipate the specific care and needs of individuals within the collection and proactively train behaviors that facilitate medical husbandry and daily management. Excluding emergency or surgical procedures, animal management and veterinary staff are able to work as a team in concert to treat and manage various conditions with less distress to the animal, as their participation in the procedure is both voluntary and cooperative in nature and a part of their regular routine. Proactively training behaviors allows the staff to plan and prepare for unpredictable emergencies and succeed when the keepers and animals are presented with unusual circumstances. Additionally, routine reinforcement training

conditions strong positive emotional responses to interaction with humans and novel equipment.

Many zoological institutions are investing in the expansion of continuing education programs and the development of training skill sets for keeper staff. Recognizing the growing need to develop more involved behavior modification protocols, the Oakland Zoo African Veldt keeper staff sought the expertise and mentorship of the zoo's volunteer training consultant, Lisa Clifton-Bumpass, who had been working with a variety of other species within the zoo. The volunteer training consultant displayed evidence of several key factors proving her qualified to fulfill this role including proficiency in teaching people how to train, a strong awareness of the sciences of animal behavior, the ability to work under the guidance of keepers, and independently assessed competency of mechanical training skills. After Lisa joined the team, under her guidance staff developed pivotal mechanical skills that allowed members to take on more intricate training projects. The training evolved from being a system that relied on simple baiting and luring techniques to the current system built with a foundation in refined behavior shaping skills.

Currently the core of the Oakland Zoo African Veldt management program is a reinforcement training skill set required for shaping and chaining simple and complex behaviors that develops the animals' behavioral flexibility, effectively providing them with the tools needed to thrive in the captive environment. Today's reinforcement training and behavior modification is rooted in the science of Behavior Analysis (BA), which is the scientific study of behavior. BA attempts to understand behavior, measure responses or change, describe and predict behavioral outcome. The keystone to the Oakland training program is a process called "Micro shaping" in which the trainer creates a systematic series of incremental behavior changes allowing the learner to function in the training environment at high rates of reinforcement and high success rates (95% and higher) as the muscle movements of the behavior are rewarded.

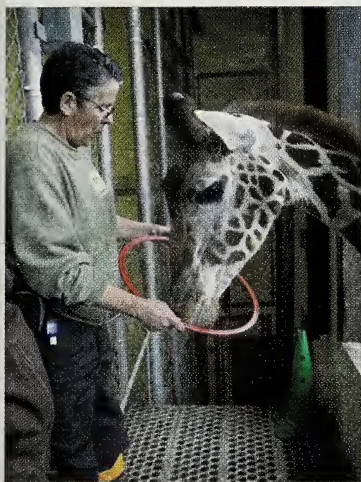
Many ungulate species are often considered animals with a low threshold for flight that demonstrates the "freeze, fight or flight" response to novel stimuli introduced into the captive environment (referred to as neophobia). The foundation of the Oakland Zoo's giraffe, eland, and gazelle training program is a series of shaping games taken from modern science-based positive reinforcement companion animal training. These shaping games are used throughout the program and are relied on to build a strong training foundation and as a tool for assessing and developing the individual's learning style. Through the employment of shaping games, learners develop into individuals that are highly adaptable in an ever-changing environment, less accident-prone, and are better prepared for unexpected events, sounds and items such as windblown trash entering their environment. Through building the process of learning flexibility, and teaching the process of interacting with multiple novel stimuli, individual animals learn that new things in the environment are positive opportunities for reinforcement. This translates to training for medical husbandry behaviors when the giraffe's first reaction when presented with a novel item changes from the fear of the freeze-fight-flight response to cooperative interaction. For example, when presented with an ophthalmoscope for the first time, a giraffe with an eye injury that had participated in these shaping games readily approached and targeted the equipment with his cheek.

The core of these shaping procedures is an adaptation of a game created by Karen Pryor, "101 Things To Do With A Box," (also called "101 Things") which is a popular tool within the companion animal clicker training community.

"This training game is derived from a dolphin research project in which I and others participated, "The creative porpoise: training for novel behavior," published in the *Journal of Experimental Analysis of Behavior* in 1969." (Karen Pryor)

In this game, the learner is introduced to a wide variety of novel objects such as traffic cones, hula hoops, medical equipment, a ball, a laptop computer, stuffed toys and carefully prescreened people who are strangers. Each training session presents a new learning opportunity to train interaction with a different non fear-inducing object. The novel object/person is presented in a manner that allows the animal to choose to interact with the object in order to have access to reinforcement. A linear progression of behavior is developed through reinforcement that allows a specific behavior pattern to be selected.





At left: "101 Things" with Hula Hoop® and above: "101 Things" with keeper wearing an unfamiliar hat.

*(Photo courtesy of Oakland Zoo)*

The careful conditioning of animal's interaction with many novel objects through tiny steps and stages is the core principle of the shaping game. In the "101 Things" game, the trainer shapes simple behaviors that encourage the animal to interact in some way with novel stimuli. The goal of the game is to create the response to new objects as an opportunity for reinforcement, as opposed to a fear-inducing stimulus. Through a series of successive, incremental approximations the trainer may build the behavior from looking at the novelty to touching it with the muzzle, smelling the object/person to pushing the cheek against an ophthalmoscope, rolling an object on the ground with its nose or foot, or placing a foot inside a hula hoop resting on the ground. An example would be shaping the behavior of standing on a radiograph plate holder to facilitate radiographs of the tips of the giraffe's pedal bones with both stillness of the foot and duration. Each of these stages is a clearly defined, reinforce-able approximation of the final behavior. The approximations are dependent on the learning style and experience of the individual animal. Initially, any glance at the plate holder is bridged and reinforced. Moving through the approximations, as behavior demonstrates that there is no fear, the plate is placed on the ground and any movement of the specified foot needed for the radiograph is reinforced in a manner that supports the goal behavior. The successive approximations build on one another in thin slices of behavior, toward the final picture.



Vet students in "Stranger Danger"

*(Photo courtesy of Oakland Zoo)*

"101 Things" has also been adapted into "The Stranger is not a Danger" game (also known as "Stranger Danger"). In this training protocol, unknown or unfamiliar humans are used in the same manner as novel objects. For example, the trainer has the carefully screened stranger stand in a location where the animal can be bridged and reinforced for turning its head in the direction of the new person. In the beginning stages it is not important if the animal looks directly at the target human, but in the direction of the new person, teaching the muscle action patterns of looking in one direction or another. The starting point for this exercise is determined by assessing the distance (or point) at which the onset of fear for the learner can be measured and therefore avoided, which is referred to as sub-threshold to the fear response. As the animal notices or looks at the stranger takes on a more relaxed posture, the "stranger" is moved forward in small increments within the animal's comfort zone, and the animal is reinforced at each stage at a high rate of reinforcement for their behavior.

After the "stranger" is within a comfortable distance,





"Stranger Danger" protocol with an out-of-uniform individual, hand feeding Dama gazelle.

*(Photo courtesy of Oakland Zoo)*

they can also be used as training targets, shaping the animal to touch the person's hand or arm with the muzzle. The "Stranger Danger Game" allows the trainer to generalize interacting with unfamiliar individuals, people wearing unfamiliar (non-keeper uniform) clothing or veterinary uniforms and equipment, effectively creating a positive conditioned emotional response to both known and unknown people. Both "101 Things" and "Stranger Danger" interaction procedures prepare animals for unforeseen emergency examinations by consulting veterinary staff, introduction to new keeper staff and volunteers to the area, as well as ensuring a high level of positive and cooperative animal participation with public feeding opportunities.

Additionally, "Stranger Danger" and "101 Things" create a strong reinforcement training foundation that builds toward target training, which supports the building of other behaviors. All training strategies rely on core competencies in measuring animal behavior, finding appropriate reinforcers and individual food preferences. Both measuring behavior and selection of reinforcement are based on strong observational skills. One may choose to measure behavior based on muscle action patterns, lack of tension in large muscle groups, rate of behavior, and duration of behavior.

Historically, keeper staff have trained the giraffe using multiple people due in large part to the sheer size of the animal and the inability of one trainer to work a behavior from the ground and reinforce at the giraffe's head level in a timely manner. In the Oakland Zoo's giraffe training program there are three key roles filled by keepers in each training session. These roles consist of the feeder (the person at the animal's head level who delivers the physical reinforcement), the trainer (the person who marks behavior), and the observer (the person who watches the giraffe's body language, collects data, and indicates readiness for the next approximation in the shaping plan). This differs from traditional group training in that there is a training plan that all members work to support cohesively. The training process starts with writing a plan, pre-briefing before each training session, the training session, and ultimately de-briefing. In group training, each person acts independent of the others and is not relying on the skills and observations of each team member. This system of team training is differentiated from group training in that each member, often with multiple animals being trained simultaneously, is an integral part in the smooth acquisition of new information for the learner. Specific to team training with giraffe, the actions and decisions of each person directly impacts the overall behavior picture of the animal. For example, if the feeder mishandles food the animal could be rewarded for behavior other than what was being bridged. Furthermore, if the feeder does not deliver food in a location that supports the desired behavior, the behavioral outcome can be counterproductive. For example, in order to get the desired behavioral momentum for a side step to a left hip target, the feeder should deliver food to the right side of the giraffe, allowing them to "swivel" the hips away from and then back toward the target.

Utilizing team training, complex behaviors are carefully shaped through the use of Micro shaping. Micro shaping is a training process developed by Kay Laurence of Learning About Dogs in England. As a shaping method, it



Team training system with giraffe

*(Photo courtesy of Oakland Zoo)*

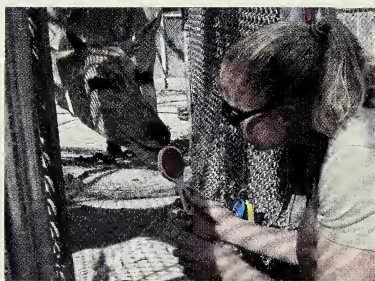


places the learner at a 95% reinforcement rate as each criterion is raised to reduce stress, frustration, aggression, and confusion as well as reducing learning or training error rates. The design of a Micro shaping plan starts with studying how the learner moves his or her body and identifying where the best placement of reinforcement should be to maintain the behavioral momentum of the action patterns. Additionally, each session is limited to a short session working on teaching muscle actions in fixed specific muscle groups. The environment is set up to increase the accuracy of reinforcement delivery to the learner without creating competing or conflicting reinforcement events. As an example, a Micro shaping session would be limited to 10 repetitions of reinforcing a giraffe for the process of lifting its foot onto the x-ray plate holder target as opposed to traditional training which would reinforce for only the event of the giraffe placing a foot on the target correctly, which results in a lower rate of reinforcement for the accidental placement of the foot on the target.

The Oakland Zoo African Veldt training program also utilizes the Micro shaping strategy. The Micro shaping strategy was developed by Alexandra Kurland as a protocol for shaping the behavior of fearful or anxious animals. In the Micro shaping strategy, shaping of new behaviors are augmented by reinforcement of well known behaviors. By breaking up training sessions of new behaviors with short sessions of interacting with keepers during a well-known behavior, the rate of reinforced behavior increases thereby reducing training stress. Returning to the model of training foot placement on a target, the learner might be asked to complete three sessions of 10 trials (or repetitions) of foot on target with a set of 10 repetitions of an already trained nose targeting behavior.



Eland on foot target



Eland calf learns a nose target

*(Photos courtesy of Oakland Zoo)*



Juvenile eland on a chin target

Micro shaping and the Micro shaping strategy allow keepers to control the animal's body movements relative to the captive environment, and position the animal for access to their body (effective in both free and protected contact management systems). The animal learns to position its body using specific movements on cue. Keepers train the animals to move forwards or backwards on the verbal cues "move up" (take 1 to 2 steps forward), and "back up" (take 1 to 2 steps backward). Hip and shoulder "move-in" behaviors are established on both the right and left sides of the body, allowing keepers to move the animal sideways. The position is maintained using a stay or station behavior. Body targets are established to control the position or placement of the nose, cheek, neck, chest, and knees, allowing keepers to slightly angle or adjust the individual's body with refined, deliberate body movements. Giraffe and eland are taught that each foot has an assigned different target (differentiated by shape, texture, and color); the target then becomes the cue for a specific foot placed in an exact location with duration. The purpose of the foot target behaviors are that they facilitate the specific placement of the feet for the application of topical treatments, detailed examination of minor injuries, proper foot positioning for high quality radiographs, and other hoof care procedures. Other verbal cues that benefit the management of the individuals within the herd are the recall (come when called) and name recognition which allow specific animals to be called into holding yards off of the exhibit reliably and expediently.

Early on in the individual's learning history, a series of basic, non-invasive behaviors are trained. These behaviors are target based in nature and serve as the building blocks towards more complex and invasive procedures. Before basic medical husbandry behaviors, such as eye exam or monitoring



respiration with a stethoscope can be accomplished, the animal must be conditioned thoroughly in order to be comfortable while being touched by both humans and medical equipment. The previously discussed training games used to condition the animals to novel stimuli facilitate the use of medical tools and equipment like otoscopes, small dental tools, and flashlights in the herd's general care. Our experience has demonstrated that as prey animals, these species generally exhibit greater relaxation when being touched on the head and neck region and an increased level of fear or stress-related body language when keepers manipulate their legs and feet, so systematic tactile desensitization procedures begin at the head and work down the body.

For tactile body conditioning and manipulation, the animal is moved into a position allowing staff safe access to the animal while reinforcing a stay position during the systematic conditioning for touch-related exercises. As physical exam, palpation, and manipulation of the abdominal and urogenital regions may be necessary, individuals are conditioned for specific medical examination protocols. Systematic desensitization and conditioning allows for trans-abdominal ultrasounds with pregnant giraffe, preliminary training for milking in preparation for potential hand-rearing of a giraffe calf, cleaning of the prepuce in bulls, and opportunistic free catch of urine samples for routine lab work. Training for physical interaction, basic exam-related procedures, and foot target behaviors are the corner stones that contribute to the skills allowing diagnostic radiographs of the lower limbs. The animal is trained to place a specific foot on its corresponding target (with duration) while the radiograph plate and portable machine are moved into position, and the image is taken.

Proactive hoof care is a vitally important part of any captive ungulate management program. Strict attention to foot care is a key component in keeping hoofed stock sound and active in the zoo environment. Training for hoof exam, trimming and filing procedures, begins with trimming from the ground, where the animal places the foot on its corresponding target (with duration) while staff remove outer wall overgrowth and take back the length of the toes as necessary. To accomplish more advanced trimming procedures that are therapeutic in nature, and to gain access to the sole of the foot, giraffe and eland are eventually taught to lift a specified hoof off the ground following a physical cue, and to balance on three feet while maintaining that position. The foot lifting behaviors are shaped so that the individual supports all of their own weight and simply shifts their balance to stand on three legs. The lifted leg remains relaxed and keepers can manipulate the exact positioning of the leg for safe and accurate inspection, trimming, and filing.



Trimming with the foot lift



Trimming from the ground



Foot soak behavior

Training sophisticated medical husbandry procedures requires moving beyond basic shaping, to more advanced shaping and chaining practices. Because the Oakland Zoo giraffe and eland have a large reinforcement history built around the face and mouth as a result of the hand-feeding practices and shaping games, training for these invasive procedures begins with teaching the open mouth behavior. As they age, dental abnormalities are often found which develop into abscesses or points on the molars and premolars that can impede the animal's ability to eat normally, resulting in undesirable weight loss and ancillary general health erosion. It is important to be able to routinely examine the entire mouth without creating high levels of stress or risk to the individual, as well as being able to safely palpate parts of the mouth and teeth.

Giraffes are trained to open their mouth following a visual cue and maintain the position while dental



tools, small flashlights, or a hand is inserted to inspect the teeth, gums and tongue. In the event of food particles becoming lodged, the cooperative trained open mouth behavior allows staff to clean or brush teeth, and provide care and treatment of wounds in the mouth, and irritation or redness in the gum tissue. Proactive dental care allows veterinarians to plan for anesthesia or standing sedation as necessary to manage and treat infections and other serious conditions that may arise.

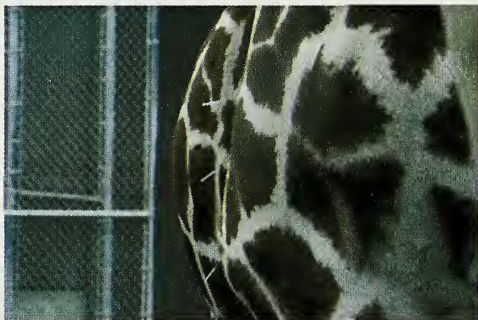


Jugular blood draw  
(Photo courtesy of Oakland Zoo)

The ability to draw blood and give injections without the use of chemical or physical restraint is an important tool in captive ungulate management. Blood samples are often required for lab work as part of a pre-shipment examination in preparation for moving animals between facilities. Specific values in the blood may need to be monitored when using drugs such as oral non-steroidal anti-inflammatories that carry the risk of potential negative side effects on the kidneys and other organs. In addition to blood work, animals often require injections to deliver necessary vaccines, contraception, antibiotics, or the use of disease modifying osteoarthritis drugs (such as glycosaminioglycans, Adequan® and Legend®) used in the treatment of geriatric

or arthritic animals. Giraffes are trained for hand injection in large muscle masses as in the hindquarter and shoulder regions. These behaviors are achieved when the giraffe is trained to the auditory cue, "move in", signaling hip or shoulder placement at a hatch door in the fencing. The giraffe then holds their position at the access hatch for the duration of the injection. The blood draw protocol is trained so that the giraffe and eland voluntarily participate in the process of having blood taken from the jugular vein. They are conditioned to tolerate the pressure of the needle stick, while remaining in position and blood is collected. The hand injection and the jugular blood draw are performed in a holding yard, at access hatches or windows where the animal is completely unrestrained and has the option to walk away from the training session at any time.

Several different types of non-traditional physical therapies are used in conjunction with traditional western medicine to treat various medical conditions and minor injuries, while both authorized and supervised by veterinary staff. Acupuncture is used as part of the pain management plan for several different individuals that have suffered various injuries, from concussion fracture of the pedal bone, muscle and tendon tenderness, chronic disease processes such as ringbone and osteoarthritis, and arthrodesis or surgical fusion of the fetlock joint. As with hand injection training, the animal maintains a stay position and allows the veterinarian to insert acupuncture needles into specific points along their shoulders, forelegs, and feet, which also facilitates injection of small amounts of vitamin B-12 into various acupuncture points as required.



Acupuncture Needles  
(Photo courtesy of Oakland Zoo)

Stretching exercises, massage therapy, and chiropractic care are utilized as an adjunct to routine integral husbandry practices in order to maintain the physical health of the animals. Stretching is a form of physical therapy that increases the flexibility of the muscles and the connective tissue, and is used with a geriatric giraffe cow to help the muscles, tendons, and ligaments maintain elasticity, thereby reducing the risk of strains or pulls. Staff members have trained this giraffe to offer each of her front legs when given the physical cue. The behavior is shaped so that the leg can be extended out in front of the shoulder or folded under, requiring the giraffe to maintain balance on three feet throughout this process. These cooperative treatments are done in protected contact, without restraint





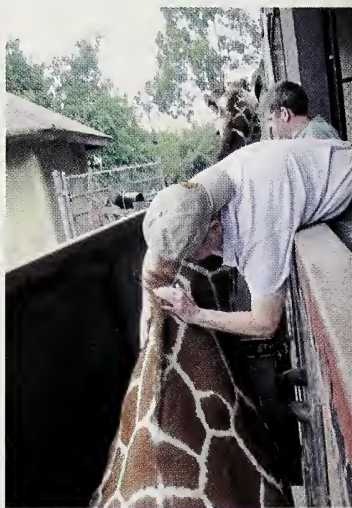
Stretching behavior with geriatric giraffe  
(Photo courtesy of Oakland Zoo)

or confinement, and the giraffe can choose to walk away from the training session at any time. The giraffe often self-stations at the treatment location, in the correct position for the stretching process and offers her front leg without being cued, when no food reinforcement is present in the environment. This requesting behavior occurs when the geriatric giraffe experiences increased discomfort as measured by limping, shuffling, muscle tension, spasm, edema and swelling.

Equine sports massage therapy and chiropractic care are routinely used in various veterinary-approved pain management protocols. Staff members use the "stay" behavior to hold the giraffe in position and the massage therapist or chiropractor gains access to the giraffe's body using step stools and ladders through protected contact barriers. Appropriate conditioning and desensitization for tactile palpation and manipulation prepares the giraffe for the handling required in a basic physical examination, but the body work associated with massage and chiropractic adjustments requires greater pressure and varying hand positions. Training for these therapies prepares the giraffe for the different types of touch, management and manipulation of their body often

associated with more invasive veterinary procedures. Keepers are currently working to train the eland for these therapies as well.

Through anticipating the specific needs of ungulates within the collection, and proactively training behaviors that facilitate medical husbandry for these individuals, staff and animals are prepared for unforeseen medical emergencies. By identifying the husbandry and management trends in the captive setting, core training is identified which supports treatment and care, and is integrated into the daily management practices. For example, the adolescent two-year-old bull giraffe in the herd, Mabusu, presented to keepers with a moderately serious laceration to the lower eye-lid, exposing the subcutaneous fatty and muscle tissue layers. Having only been part of the Oakland Zoo's herd for just over one year, Mabusu's training history consisted of two primary shaping games: 101 Things To Do With Your Head, and "Stranger is Not a Danger". His participation in these games allowed for the building of a strong



Chiropractic Adjustment  
(Photo courtesy of Oakland Zoo)



Massage Therapy (Photo courtesy of Oakland Zoo)

reinforcement history that included his face, the closeness of strangers, and the interaction with novel looking and smelling objects. Previous to the injury, no invasive eye care protocols had been trained or undertaken. As a result of the injury, the immediate emergency first aid care required flushing and the application of eye antibiotic ointments followed by routine medical evaluation requiring examining strangers to come within inches of his face, prolonged close examination the eye with a pen



light, thorough eye flushing, twice daily application of antibiotic ointments, and regular examination by staff.

The process of teaching "101 Things" and "Stranger Danger" allowed for Mabusu to avoid dangerous anesthetic procedures and invasive surgery. As a direct result of the conditioning to new people, targeting his face, and exposure to novel objects resulted in reinforcement history that allowed Mabusu adapt quickly and enabled the close examination of his eye by the zoo's visiting veterinary eye specialist. As another example, 1.1 eland in the Oakland herd contracted a serious infection, with the bull becoming ill several months after the cow. Their training and experience with the aforementioned training games allowed staff to be able to isolate them as needed, place unfamiliar equipment in their holding stalls, facilitate stress-free visits from unknown veterinary staff, and medicate several times per day as protocols required. It also allowed for low-stress physical examination and very close monitoring of weight and body condition throughout this serious illness.

This extensive training program has facilitated the building of bridges between zoo staff, advanced expertise from non-zoo specialties and the research community, and has provided unique treatment



Giraffe in EEG equipment (Photo courtesy of Oakland Zoo)

mechanisms for coping with unforeseen medical difficulties. The trained voluntary jugular blood draw enabled the zoo to participate in a nutrition study, and provided staff with the ability to pull blood to assist another institution in boosting the immune system of a hand-reared giraffe calf. Tactile training for palpation of the abdominal and urogenital region allowed staff to hand milk an injured giraffe cow in the event that she was unable to care for her newborn calf. Due to the animal's ease and comfort with keepers carrying novel objects and moving around their bodies in close proximity, urine can be easily collected as needed and has allowed the zoo to participate in important research

examining the relationship between diets and urolith formation in captive giraffe. The Oakland Zoo has also participated in the preliminary stages of a giraffe EEG (electro encephelogram) study with initial findings and the first recorded brain activity.

The voluntary participation in medical and husbandry procedures as a result of positive reinforcement-based training and Behavior Analysis has many direct benefits for the animals. Positive reinforcement-based training can be successfully employed in both free and protected contact systems. It is an effective management tool for facilities that use a restraint device as well as for facilities that do not have access to restraint equipment. It is recommended that all zoological facilities exhibiting giraffe employ mechanical restraint devices capable of facilitating standing sedation or general anesthesia as a treatment mechanism for surgical procedures that cannot be accomplished by training. However, effective training procedures reduce the need for physical force typically used to gain compliance. Reinforcement training can be used in all environments including a restraint or chute, without the use of the device's squeeze capabilities, by employing the chute as a hallway, allowing safe access to the animal's body.

Careful training for medical procedures by keeping the process voluntary in nature for the animal, has demonstrated less measurable distress associated with the protocol, equipment and specific staff. The animal does not struggle, fight or attempt to escape, and the process is conducted with a higher degree of safety for both the animal and the humans involved. Ungulates that are conditioned to a wide range of novel stimuli and environmental conditions demonstrate a strong conditioned emotional response to all aspects of their captive environment. They exhibit a quantifiable reduction in the fight

or flight response and are less reactive to “unexpected sights and sounds” overall. This program has shown that methodical training systems have multiple benefits. By thoroughly conditioning animals, they become safer to work while in close proximity, and have fewer accidental injuries resulting from spooking or bolting.

In conclusion, reinforcement training shapes animals that are less stressed, yhat present a greater repertoire of natural behaviors while on exhibit, making them better ambassadors for their wild counterparts to the visiting public. Additionally, thorough conditioning allows both the animal and keeper staff to have the tools necessary to provide for the needs of animals without creating avoidable distress, allowing animals to thrive and function well in the captive environment. Effective and humane care entails an understanding of the natural history of the species, species ontogeny, and reinforcement training skill sets. This planning prepares the animal for potential husbandry and medical issues in advance, instead of addressing emergencies as they arise. Preparation for the unanticipated events that can develop throughout the animal’s life protects the individual from unnecessary risk and emotional distress.

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Behavior Analysis in Animal Training 5/29/09 [www.behavior.org/animals](http://www.behavior.org/animals)

[www.clickertraining.com/node/167](http://www.clickertraining.com/node/167) (101 Things)

[www.clickertraining.com/node/1627](http://www.clickertraining.com/node/1627) (Micro Shaping)

## Resources

Animal Cognition – [www.animalcognition.net](http://www.animalcognition.net)

Cambridge Center for Behavioral Studies – [www.behavior.org](http://www.behavior.org)

Applied Behavior for Animal Training Courses

[www.learningaboutdogs.com](http://www.learningaboutdogs.com) (internet based shaping and Micro shaping courses)

[www.naturalencounters.com/trainingEducation.html](http://www.naturalencounters.com/trainingEducation.html)

[www.sheddaquarium.org/adult\\_programlistings.html#ADULT\\_PROGRAMS](http://www.sheddaquarium.org/adult_programlistings.html#ADULT_PROGRAMS)

[www.legacycanine.com/workshops/chicken-camps.html](http://www.legacycanine.com/workshops/chicken-camps.html)



Reticulated giraffe  
Artist: John E. Wyatt



# **TACTILES - The Transition from a Behavior to a Reinforcer:** **a case study of 1.0 Grant's Zebra (*Equus burchellii*) at the Oakland Zoo**

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## **Abstract**

The Oakland Zoo Animal Management Department has developed many strong, keeper-driven, training programs that focus on increasing animal welfare including the development of voluntary medical and husbandry behaviors, generalized desensitization, and reduction of stress. Many of the behaviors are



Photo 1. Injection & blood draw training  
(Photo: Oakland Zoo)



Photo 2. Training left leg behavior for  
hoof care (Photo: Eric Beckman)

prioritized in the training programs either in response to a current need or in anticipation of potential future medical issues. They allow closer animal health observation and facilitate medical treatment. The zebra training program at the Oakland Zoo has evolved greatly over the last few years from a desensitization-based focus to more advanced medical and husbandry behaviors including open mouth, foot targeting, directionals, injection (see Photo #1), blood draw, and hoof care (see Photo #2). One interesting and important result of this evolution is the transition from training a tactile behavior to the tactile stimulation itself becoming a reinforcer for a specific, individual animal. This transition has allowed trainers to use tactile stimulation to build a stronger relationship with the animal that facilitates in the training of more advanced behaviors. There are many successful training programs based on tactile reinforcement, but what makes this situation unique is that the tactile interaction was not something the animal initially offered but was rather a trained, cued behavior using food reinforcements and evolved outside of the training environment into a reinforcement option for the training program.

## **Training the Tactile Behavior**

All zebra training at the Oakland Zoo is done in protected contact. The specific parameters are that people never enter the exhibit or barns when animals are present in that space and that a fence or barrier is always between animals and keepers. Most training occurs at the cable fence of the large exhibit yard that has no walls, chutes, or other containment barriers allowing the animals to walk away at any time (see Photo #3). While sometimes challenging, this situation does prevent the trainer from pushing past the animal's comfort level since there is nothing physically keeping them in close proximity to the trainer. This lack of containment compels the trainer to become acutely aware of the animal's body language, focus, and indicators of stress so that the trainer can maximize the productivity of the training session.

The purpose of tactile training was to facilitate application of topical agents, such as fly repellent, and to allow closer inspection of animals for health checks. Rather than training a passive permission of tactile stimulation (where the trainer reaches out and touches the animal), it was decided to allow the animal to initiate tactile stimulation thus reducing the potential of the trainer to push past the animals comfort level and giving control of the tactile stimulation to the animal. This could ease any potential stress of the stimulation.



We bridged first for the animal calmly allowing the trainer to present a hand just inside the fence. Through observation of the animal's response to different methods of presenting a hand we determined that the backside of the hand facing the animal and the trainer facing the same direction as the animal promoted calmer more consistent responses. Next we bridged successive approximations as the animal moved its body closer to the trainer's hand. Initial contact was aimed at midway down on the zebra's neck since the animal seemed most comfortable with this location. This also facilitated the animal lining up parallel to the fence, maximizing the extent of the animal within reach of the trainer from the fence for future tactile work.



Photo 3. Group team training at exhibit fence.  
(Photo: Oakland Zoo)

The presentation of the backside of the trainer's hand became the cue for the animal to lean in and touch its neck to the trainer's hand (see Photo #4). Building from there, the trainer increased duration of touch, pressure of touch, rotation of the hand to the palm touching the animal, and movement of touch on the neck. All of these variables were built with the zebra holding the tactile contact until the trainer bridged and reinforced with food. If the zebra pulled away before being bridged, the trainer's



Photo 4. 'Lean-in' tactile behavior cue  
(Photo: Oakland Zoo)

hand would not follow to maintain contact. Instead, the trainer would offer the cue again and look for opportunities to bridge before the animal terminated contact; this sometimes meant temporarily lessening the criteria established at that time. Also, it is important to note that the trainer's hand cue was presented just inside the fence and not extended to its full arm's length into the animal's space. During the training of the tactile (and the majority of the zebra training) food rewards are used as reinforcement.

### Behavior & Body Language

A keen awareness of equid body language has greatly aided in the progress of the Oakland Zoo zebra training program. It specifically helped to determine how to build the tactile behavior while

respecting the animal's limitations. Animals communicate with one another through behavior and body language. Knowledge of species-specific body language/behaviors can help a trainer make a best guess hypothesis about the animal's state of being. Equid social communication can be broken into four main categories: auditory, chemical, tactile and visual (Mills & Nankervis, 2003). As trainers we rely primarily on interpreting visual behavior cues to help direct training sessions. Equids communicate with one another in many visual ways including facial expressions, body postures, behavior sequences, active behaviors, direct interactions, and more (McDonnell, 2003). Observing small, subtle, body language cues or behavior changes that occur during training can be useful in determining whether the zebra is excited to participate, willing to participate or if they are uncomfortable. While an uncomfortable zebra may still participate in training, it will not be in a relaxed manner and the retention of the learning from the training session may be diminished.

Behavior cues that we have observed during training include: keeping distance from the trainer, ear pinning, ear turning (from where they are listening), how gently they take food, tightness of the facial muscles, how large the eyes have become, teeth baring, alignment with trainer, awareness/interaction with a neighboring animal, tenseness of leg joints, and stomping. Alert zebras will have their ears erect and their head in an upright position with eyes wide open, but not bulging or whites of eyes showing (Schilder & Boer, 1987). If their ears are erect but turned backwards they are directionally listening to what is behind them. Ear pinning is different in that the ears are not only facing backward but are also



pressed flat against their head. This is often a sign of discomfort, frustration, or aggression (McDonnell, 2003). Other cues that are being presented with ear pinning will determine how to interpret the body posture. For example, if the ears are pinned backwards in addition to having a lowered head, this behavior is associated with submission and fear (Schilder, et al., 1984). Tight facial muscles, as indicated by more wrinkles along the jaw line, may be a sign of discomfort or aggression. Quick grabs for food using the teeth and not the lips, in addition to stomping, can be signs of frustration or aggression. Large bulging eyes or eyes with the white showing around them can indicate heightened alertness, fear, or be a precursor to aggression. While tail swishing can be a defense against flying insects it can also be an indicator of an animal's comfort level. Unlike dogs that wag their tails when they are happy or excited, with zebra we have found that the faster the tail swishes, the more alert and reactive the animal will be and the less likely they are to focus well in a training session.

Specifically related to tactile stimulation, we have observed that a relaxed zebra will have eye lids that are partially closed, relaxed loose facial muscles, slightly lowered head, and soft lips (see Photo #5). The lips will tremble slightly, a natural reflex associated with social grooming behaviors (Kurland, 2007). Occasionally the zebra may stand with one rear leg bearing little to no weight on it or rolled slightly forward with just the tip of the hoof on the ground.

### Solicitation

At the Oakland Zoo keepers walk by the zebra exhibit many times during their routine duties and, unless they are carrying the treat buckets that indicate a training session, the zebra typically ignore them. Occasionally when a keeper paused to observe the animals, an individual male zebra would approach the fence. With increasing frequency he approached keepers outside of training sessions and he soon began to line up parallel to the fence and would present his neck for his lean-in, tactile behavior. Initially there was some concern about the behavior breaking down if it was done outside a training session and without primary reinforcement (food/treats), but the solicitation for tactile stimulation persisted. Keepers did not bridge for these tactile sessions outside of formal training sessions, and clearly indicated that there was no food present by showing empty open hands when he approached – yet he continued to present for tactiles, stayed for increasingly longer durations and even lined up different parts of his body for tactile stimulation. The keepers would stay relatively planted in one location at the fence while the zebra moved forward or backward, turned left or right and leaned towards the keeper's hand to present various sites on his body to be rubbed. If he lined up in an unsafe direction, putting the keeper directly behind his rear legs, the keeper would simply step away from the fence until the zebra was in a safe position.



Photo 5. 'Relaxed' facial indicators  
(Photo: Oakland Zoo)

During this time tactile behaviors were still reinforced with food rewards during formal training sessions. The range of tactile stimulation permitted on the body was greatly increased during these training sessions reflective of the informal, tactile sessions. With time, the animal became increasingly relaxed with tactiles as indicated by loose quivering lips, soft facial muscles and swaying of the animal's weight back and forth in response to minimal pressure by the trainer.

As he became more comfortable with diverse tactiles during training sessions and continued to frequently solicit tactiles outside of training sessions, we began to wonder why the animal was soliciting the tactile outside of primary reinforcement opportunities (training sessions). Clearly, after months of not receiving food for tactile stimulation outside of formal training sessions, he is not soliciting this behavior for an edible reward. Was it possible he "enjoys" the tactile stimulation and solicits it purely for the resulting interaction?

### Equine Massage Therapy

We consulted with an equine massage therapist who, conveniently, was already working with a giraffe at the zoo. The equine massage therapist shared information on massage techniques, advising on body locations, muscle directions, and various types of tactile stimulation most successful with



domestic horses. She invited one of the zebra trainers to come out to watch her work on a horse and get some practice on a less reactive equid before trying the techniques with the zebra. During this work we discussed the effects of muscle direction, joints, pressure points, nerve locations, and bones in



Photo 6. 'Armpit rub' equine massage technique  
(Photo: Jason Loy)

applying equine massage techniques. Using this information in conjunction with equine clinical anatomy references, the zebra trainers were able to further diversify the tactile stimulation options when working with the zebra. As a result of experimenting with various tactile techniques during solicited tactile interactions (outside of formal training sessions), we have found that this individual male zebra "prefers" (more frequently lines up for and stays longer engaged in) tactiles on his rump (long strokes downward using the heel of the hand); hip (circular or "S"-shaped sweeping strokes avoiding bone points); side, neck, armpit (back and forth sweeping motion using palms of hands – see Photo #6); chest (circular curry comb strokes using the finger pads); and sometimes his

cheek. He moves his tail to the side when his rump is massaged, allowing massage at the base of the tail and tail pulling (see Photos 7 & 8). In the equine massage field, "tail work" is considered a massage relaxation routine.

Experimenting with various techniques outside of the formal training sessions allowed the animal to direct and control more aspects of the interaction such that it was more reflective of his "preferences". During formal training the trainer directed the contact details of the tactiles (location, pressure, direction, duration, etc.). The animal touched using the lean-in behavior and the trainer terminated the tactile by bridging and offering food reinforcement. Although we wanted to learn what he "liked," we didn't want the trained, tactile behavior to become restricted to his preferences.

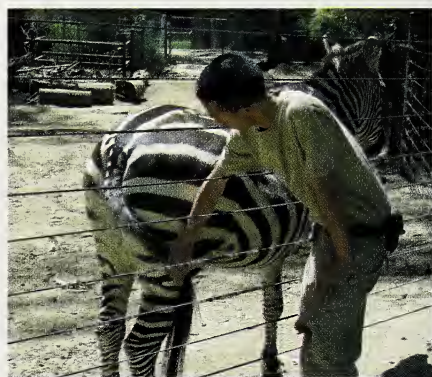


Photo 7 (left) and Photo 8 (above) show  
'Rump & tail work' massage technique.

(Photo: Leesa Whittle)

### Transition from Cued Behavior to a Reinforcer

Reinforcement (or punishment) is a reflection of the receiver's perspective. If an animal (such as the Oakland Zoo zebra) does not like apples and an apple is offered as a reinforcer for a behavior, it will not be reinforcing to the individual receiving it and will not increase the frequency of that behavior occurring again. Knowledge of an animal's preferences and what they may find to be reinforcing can be used to create effective training tools. We found that even if food rewards were offered while this individual was receiving unsolicited tactile stimulation, particularly the "preferred" techniques, he would ignore the food until the trainer discontinued the touch. Even then, he would frequently disregard the food and realign and engage in tactile solicitation with the trainer. However, just because



an animal refuses treats/food or gives a lack of resistance to tactile stimulation it is not fair to assume it is because it “enjoys” its circumstances. There are situations where an animal will refuse food or fail to provide resistance due to many things including stress response, resignation to undesirable situations/circumstances, anxiety about what will happen next, health conditions, or even learned helplessness. Animals held and controlled under manual restraint scenarios will often resign to the situation, stop struggling against the restraint, and appear to “relax”; additionally, they may not take food offered during restraint or immediately after release – but it is unlikely that the animal being restrained finds the situation reinforcing.

We wanted to make sure we were looking at the entire picture of the tactile experience for the zebra including his behavior, body language cues, specific scenario details, and parameters under which the situation of solicitation of tactiles evolved. Keeping in mind that this was tactile contact initiated by the animal, maintained by the animal, without confinement, outside of any movement restrictions on the animal, outside of formal training session cues, with other food options readily available that were not connected to the tactile situation or trainer, and involving consistent, comfortable relaxed body language by the zebra, we were inclined to perceive that this individual animal found the tactiles reinforcing.

Using this information we decided to try using what we learned about this individual animal’s “preferences” during the unsolicited tactile sessions as another reinforcement option during a formal training session. First, we associated the bridge with receiving the “preferred” tactile stimulations. This was done the same way as associating a food reward – the trainer would bridge (whistle) and then offer one of the “preferred” tactile techniques. Next, we asked for basic, well-trained behaviors, such as target; we bridged for successful execution of the requested behavior and reinforced using the “preferred” tactile stimulation. Over time, we have found no breakdown in the behaviors using the tactile reinforcement. Additionally, we have found that we are able to use the tactile behavior to build more complex behaviors that involve a tactile component such as injection training, blood draw, application of topical agents, and foot lifts.

An important acknowledgment is that a significant component of the reinforcement value of the tactile stimulation is likely a reflection of a trainer’s relationship with the animal, the animal’s comfort and trust with an individual trainer performing the tactile stimulations, and that person’s awareness of the animal’s preferences and body language through numerous interactions. That is not to say that the tactile’s reinforcement value is limited to one trainer, but rather that each trainer using tactiles as a reinforcer must first spend time learning the animal’s preferences, the particular nuances of body language and behaviors, and techniques used by other trainers. In any training program, and even more so when working with tactile reinforcements, we must be careful, as humans that naturally crave contact, to honestly interpret an animal’s behavior and avoid interference by our potential, personal desire for special animal connections. This leads to one more important distinction – this tactile reinforcement dynamic only applies to one of the four zebra in the Oakland Zoo training program. It is hard to interpret the many potential variables that may have contributed to why tactile stimulations evolved from a trained behavior into a behavior reinforcer for this individual and not the rest of the herd. However, as stated earlier, reinforcement value is a reflection of the receiver’s perspective and at this point the other three female individuals have not indicated with their behaviors that they share the male’s perspective in regards to the value of tactile stimulation. Just as we are all individuals with our own preferences, so are the animals. A thorough training program will take into account individual differences and preferences as well as species similarities.

## **Conclusion**

Using tactile stimulation as a reinforcer can have many advantages, the most obvious being the ability to train without cumbersome food buckets or additional calories. We’ve also found that when there is no food around, in this situation where only one individual solicits tactiles, we can train him without the other animals competing for access to the trainer. Additionally, the ability of the trainer to use tactile reinforcement eliminates the need to quickly return to the front of the animal’s head to deliver food, which permits the keeper to stay set in other locations for behaviors that involve squatting, kneeling, and



Photo 9. Leg work and hoof care training.  
(Photo: Eric Beckman)

other similar positions. When working a foot lift the trainer can reinforce with an armpit rub tactile while staying set in position to perform another foot lift much sooner and with minimal disturbance to the animal's positioning (see Photo #9). This reduction in movement by the trainer helps to keep the animal calm when working more advanced or sensitive behaviors.

By developing a tactile behavior in which the animal actively engages the tactile stimulation and has the ability to terminate the tactile contact, this individual animal became comfortable enough to solicit and advance tactile contact outside of

primary reinforcement opportunities. Furthermore, by allowing the animal to control the duration, location and pressure of tactile stimulation outside of formal training session, keepers were able to learn the particular types of tactile stimulation the individual "preferred." Keepers were able to use those observations from the solicited tactile sessions outside of training, as well as the information from the equine massage therapist to direct and progress the formal training sessions towards more advanced behaviors including foot lifts for hoof inspections and working towards future voluntary hoof care.

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# Bongo (*Tragelaphus euryceros*) Calf Splaying and Coxofemoral Luxation

*By Lydia F. Bosley, Bongo International Studbook Keeper  
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Since taking over the bongo studbook in 1997 I have received a few random reports of calves splaying (rear legs spread apart; "splits") shortly after birth, often remaining unable to stand and to nurse, and usually dying within two or three days. A few locations have had this problem occur a number of times, and have asked for help in determining the causes and any solutions.

With the annual requests for taxon reports for the year 2002, I also asked for any information from people experiencing this phenomenon in their collections, and I made specific requests for specimen reports or necropsies/post mortems or other data on all calves that died soon after birth during the last five years.

As the responses began to come in, it became quite clear that this splaying of the hindlimbs was a fairly widespread condition, with American and European locations experiencing it in roughly equal proportions. From studbook records of 359 (total) births over the past five years, 70 calves had "early deaths" (within two weeks of birth, and 75% of these were within two days), and 34 of these 70 deaths (49%) were attributed to or affected by the splaying problem. This does not account for possible additional cases in which I received no responses to my inquiries. With another few random reports added in from '91, '95 – '97, and three from '03, the total number of reported cases considered in this study is 43.

In the following sections I will give an overall description of case histories, compiling and consolidating typical occurrences, symptoms and findings, followed by a summary of recommendations by individuals and institutions who feel they have a solution to the problem and ways to help overcome it. Now that I have finally addressed this issue, I feel confident that the advice and remedies offered will definitely help some, if not all, rid themselves of this problem.

## Case Histories

A typical case includes descriptions as follows: weak, inability or difficulty in standing/walking (27x), with just a few (5) other calves 'appearing normal' or healthy at first and then suffering a decline; four calves were described as being well below normal weight (which is around 40-50 lbs./ ~18-23kg). Splaying is common (18x), as are observations of abrasions (8x) on legs and feet (medial stifles, carpi, tarsi), or hematoma/bruising in the hock/carpal region.

Failure to nurse/inanition/emaciation/cachexia were cited in 14 cases, and in one more case the problem was possibly complicated by a digestive tract obstruction of fibrous material (straw and grit) ingested inappropriately. Twice, failure of passive transfer was mentioned.

Coxofemoral luxation was specifically mentioned 17 times, with additional descriptions of femurs displaced or dislocated, rupture of joint capsules and ligaments, 'shallow acetabuli', and one spinal luxation at L2/3 in addition to femoral luxation. In less detailed accounts, musculoskeletal trauma and/or mechanical abnormality may have been the only descriptions given.

To remedy the dislocations, in three cases, closed reductions were tried, and in three others (at least one was the same case), open/surgical reductions were attempted; none of these calves survived.

Post-mortems citing luxations were typically accompanied by reports of resulting extensive hemorrhage

in inner thigh/haunch/caudal to thigh/internal inguinal area/medial aspects of both hips, or extensive hemorrhage throughout musculature. There was one specific mention of a torn artery in the haunch, and one of a periinguinal hernia.

One necropsy described the pectineus muscles as appearing malformed and torn, and hypothesized a bilateral congenital malformation of the pectineus muscles, (causing bilateral femoral luxation). There was one mention of contracted tendons bilaterally in rear limbs, and one p.m. cited moderate atrophy, with rear-limb muscle mass decreased. Overall, however, the majority of the injuries found in the post mortems are secondary to the occurrence of splaying.

One rare exception survived and overcame extremely small birth size (23 lbs./10.4kg), weakness and inability to stand – as well as urinating from vulva and umbilicus (this occurrence was also mentioned in one other case). The calf in question (Pretzel) was, on the 2<sup>nd</sup> day, walking tenuously; pulled for hand-rearing, it had a good sucking reflex. “Unsteady but bright and alert” was the description on the 4<sup>th</sup> day; 3 1/2 weeks later, the calf ‘anorexic’, nursed well after the formula was changed, and at a little over a month the calf was “frolicking in a grassy enclosure” (*Editor’s note: Pretzel/930 died at age 14 years in November of 2010.*).

Two calves’ leg problems were attributed to being ‘pulled’ during difficult births; one was a breech presentation of an oversized calf. Other conditions mentioned in conjunction with those previously described were pneumonia (“hypothermia because of lack of movement?”), colisepticemia, septicemia at umbilicus (5-6 cases), and in one, “histopathology most suggestive of white muscle disease”.

In several cases the dam’s behavior was thought to be causative, but it seems possible that these were suppositions vs. actual observations, e.g. “dam apparently inflicted injuries”, “mother stepped on calf” (not sure if this was seen or presumed), and “dam aggressively cleaning calf, preventing it from standing”; in another case the dam bit the calf’s ear in an attempt to get it to stand.

In the following individual cases, a few described various remedies attempted.

In one, bottlefeeding was unsuccessful, tube feeding was tried, the calf regurgitated, aspirated, became recumbent, agonal, and died five minutes after tubing.

Some had a protocol calling for Vitamin E/Selenium supplementation in the third trimester; another curator, after five successive deaths, ‘suspected’ a selenium deficiency.

In a number of the aforementioned cases hobbles were tried – unsuccessfully more often than not, in these particular cases, but it has helped in others, according to more general reports and suggestions from other institutions.

More references to flooring/bedding will follow in the next section, but within the individual cases being considered here, a few specific references occurred; in one case a vet simply suggested better flooring as this was the second incident [of a calf splaying]; another referred to adding sand and improving the footing; a third case documented the calf splaying due to a “not deep enough bed, with fresh straw slipping on the smooth concrete floor; all subsequent calvings on very deep and well-established straw litter ensured firm footing” (this party also mentioned splaying in giraffe [*G. camelopardalis*] and Nile Lechwe [*Kobus megaceros*]).

In another record a calf splayed, was ‘moved out to the patio for better footing’, and the 2<sup>nd</sup> day the straw in the stall was replaced by wood shavings. One report cited a calf born in a stall with the rubber mat incorrectly positioned “slick side up”; the calf splayed, dislocated its hips, and was euthanized.

One location mentioned a dam having a history of producing splaying calves (perhaps suspecting a



genetic/hereditary link?), another described successful births from the same dams and sire previous to splaying-related deaths (questioning a genetic factor?), and a third cited bad luck with a substrate used previously and subsequently for successful births. One more facility mentioned having successful sitatunga [*Tragelaphus spekeii*] births with the same regimen as their bongo group that was having problems.

### Summary of Recommendations and Suggestions

Having made a general request to all (~120) bongo holders for any comments, ideas, and/or recommendations on how to deal with or solve the splaying problem, a group of about 20 locations responded with specific comments. These particular locales were linked to 65 "successful" births or calves living past the end of the five-year period. (Out of the 92 institutions reporting births within the period, those with splaying-related early deaths numbered 32, and combining that group with those 20 reporting success using particular methods, this does not account for the remaining 40 locales, and nearly 200 additional "successful" births. These other holders must also be "doing something right" but without any descriptions of their methods, it is unclear to what their successes can be attributed.)

The positive responses focused primarily on footing or bedding, with a few references to diet, especially supplements of Vitamin E and Selenium, and possibly Copper. A number of holders used hobbles to remedy splaying. According to population analysis, there is no apparent hereditary factor in the condition.

A combination of dirt or sand, and often, deep bedding on top of that, seem to be the preferred elements in an ideal calving substrate. Descriptions such as "high litter", "deep bedding", "a mattress of shavings and Lucerne" occur repeatedly, as well as mentions of "2-3 inches of dirt, neither extremely loose nor hard packed, in birthing stall" or "6-8 inches of sand on top of concrete". In temperate locales (e.g. San Diego) calves may be born "on exhibit" in group paddocks surfaced with decomposed granite and sand, or an outdoor, separate "sand-bottomed corral", but it appears that the majority of zoos prepare special "birthing stalls" in which the dam is isolated from the group and in which she and the calf will remain for several days. A couple of places also mentioned protecting the young calves for a few days from aggressive Grevy's Zebra [*Equus grevyi*], particularly in mixed-species exhibits.

Stuttgart uses perhaps the most complex preparation of a special birthing stall, with layering of thick sand, wood shavings, straw and pieces of bark, kept slightly humid and compressed; noting that it could be a likely medium for parasites and bacteria, they caution that it should be removed as soon as the calf is safely standing (2-3 days after birth) and replaced with dry bedding.

Several locations mention the use of rubber mats, with or without shavings or bedding on top; the mats are textured, including one which has holes of 3cm (1.2 inches) all over the surface. Mats have been used 'under hay' in hand-rearing cases as well. Conversely, a mat turned "wrong side up" with the slick surface exposed was blamed in at least one case for the calf's splaying and subsequent euthanization. Concrete surfaces alone, even when roughened, are typically implicated in splaying cases, especially when blood/membranes are present, and some people mention that their success is due to having "no concrete, just grass" even where calves had weakness (but no splaying).

A number of holders describe specific incidents in which a calf splayed, some immediate adjustment to the substrate was made, and the calf successfully recovered. A single incident where the dam dropped her calf early and unexpectedly, on a surface of roughened concrete, heated, with dry straw bedding, resulted in the calf splaying, but when the usual dirt plus thick bedding surface was prepared, the calf recovered.

In adjusting their protocol, another location tried "just deep shavings" over concrete one year; the calf splayed, they added dirt over the concrete, and "the calf did fine". A zoo cited several incidents

of splaying in calves born on concrete floors, they now use 2-3 inches of dirt, and that "solved the problems". Another location had calves splay on hard-packed dirt, they changed to rubber mats with holes and a thick layer of shavings, and this worked. The institution that uses a "mattress" of shavings and Lucerne had calves splay previously, but since changing to this footing the last two have stood alone and survived. Several more testimonials were offered for the importance of the substrate to calf survival, particularly in calves that may be underweight or otherwise compromised at birth.

A couple of collections have dealt with splaying incidents in other species, including Nile Lechwe, angora goats [*Caprin angora*], giraffes and even ostriches [*Struthio camelus*]. All attribute the problems to hard slippery surfaces (concrete floors or hard-packed clay), and births on grass or "rough natural turf" have given better support to "weak young legs". At one zoo, giraffe calves have benefited by being lifted up to nurse 3-4 times the first day, and in each case the calf could stand on its own on the following day.

Dietary factors contributing to splaying were concerns in a number of zoos; expressed variously as "a suspicion of Vitamin E / Selenium deficiency" after four splaying-related deaths, to a routine protocol for E/Se supplementation in dams, calves or entire herds, these elements are believed by many to be important in the prevention of weakness, white muscle disease and splaying.

Recommended Levels for Vitamin E are between 100 – 200 I.U. (International Units) per kilogram DM (dry matter), and for Selenium, the level should be 0.2 – 0.3 mg/kg DM.

For a couple of specific cases, the managers changed substrates and augmented Vitamin E/Se levels at the same time; although improvements were seen in calf survival rates in these cases, it is impossible to attribute them to either of the two confounded factors. A number of locations routinely supplement the dam with E/Se injections in the third trimester of pregnancy, and one (eastern European) zoo testified to the importance of the dam's overall diet; they use "SANO premix" or "VITAMIX" added to regular diet, two days before delivery the female receives an E/Se solution, and on the second day after birth, calves are tested for blood glucose levels and also receive E/Se injections.

Dr. Ellen Dierenfeld\*, Wildlife Conservation Society/Bronx Zoo, also raised the possibility of copper deficiency "possibly mediated by too high dietary protein", as it has been seen to cause ataxia in other ungulate species (Blesbok [*Damaliscus dorcas phillipsi*] and Yak [*Bos grunniens*], in particular).

Recommended Level for Cu is 20 mg/kg DM in Blesbok

A final management technique in remedying splaying is hobbling; a number of institutions have successfully applied support wraps to splaying calves with the result that 2-5 days later the calves can stand on their own.

A couple of different variations are described, as follows:

Two locations used hobbles at the hock level, first wrapping soft "cast padding" or the like around the leg just above the hock, then using cling gauze or Vetwrap® around that, and finally taping the legs together (with hocks spaced about the same width as the shoulders, or slightly wider) with a one or two-inch non-stretch type bandaging tape, several thicknesses for strength, sticky sides together. Small pieces of tape were used to prevent the hock-wrap from slipping down, but as little adhesive as possible should be applied directly to the hair coat.

Another zoo used two-inch bandaging tape alone, at fetlock height, first forming snug (but not tight or constricting) loops of doubled-back (non sticky) tape around each fetlock, and then taping the two legs together (again doubling the tape, sticky sides together) at an appropriate width to allow stability and some freedom of movement but not much lateral spreading. Gauze or padding could also be used under



the tape loops around the fetlocks but is thought to be unnecessary – just as long as the tape itself isn't stuck directly onto the hair.

One of the above institutions (Saint Louis Zoo) keeps hobbling materials on hand for all births, due to the high incidence of splaying in the past, and the calves are watched closely until they have stood and nursed successfully several times; if they splay, they are hobbled immediately. These calves are also monitored for temperature, blood glucose, and body weight, and are given supplemental feedings if weak. The hobbling lasts 2-5 days depending on the calf's progress, and hobbles may be changed several times if necessary. Records indicate one calf of 34 lbs./15.42kg splaying, being hobbled for two days, and not splaying after that; a second calf (whose dam did not survive a C-section) splayed, was hobbled two days as well, and was successfully hand-raised with no more splaying; a third calf (weighing 45 lbs./20.4kg) was hobbled for five days, continued to splay occasionally after that, but could always get up on her own.

In other species, binding of the legs has helped Lechwe calves, and artificial supports have also been used on weaker giraffe calves. Apparently the domestic dairy cattle industry often has incidents of "leggy" calves splaying, and hobbles are used there as well; searching the Internet, I came across at least one website ([www.coburnco.com/products](http://www.coburnco.com/products); search for "hobbles") which advertised nylon and Velcro® adjustable hobbles for sale.

### **In Summary**

Those bongo holders that have overcome their splaying problems typically attribute their successes to improved substrates (usually incorporating a 'natural' base of sand or dirt, with thick/deep bedding atop that when used in stalls), to dietary supplements (most usually Vitamin E and Selenium), and to wraps or supports on the legs of calves that may still splay.

Careful monitoring of bongo calvings is definitely indicated, and on the whole it seems that separating the dam and calf from the group for several days, in a deeply bedded stall, is the usual practice, although a few have success leaving the dam with the group outdoors where there is a natural substrate (and an absence of Grevy's Zebra!).

Further research would be necessary to discover the remaining routines and techniques used in those unreported cases of successfully surviving bongo calves, but it is clear that undertaking the above-mentioned practices should go a long way toward solving the splaying problem.

I am very grateful to all who have volunteered information for this study, as well as to those who have aided me in making this article more accurate and concise.

My thanks go to (in alphabetical order): Angela Anderson, Daniel Baffa, Katrina Baumgartner, Peter Birch, Mirek Brtnicky, Mark Challis, Ludek Culik, Andrea DeMuth, Pereira DeSilva, Ellen Dierenfeld, Ph.D., Cecile Dubois, Mark Edwards, Ph.D., Norah Fletchall, Eva Gregorova, Vickie Kunter, Laurie B. Lackey, Diane Lucio, Fran Lyon, Carmi Penny, Randy Reiches, Eric Bairrao Ruivo, Guenther Schleussner, Dale Schuster, Steve Shurter, Ilse Stalis, DVM, Ron Surratt, Barbara Toddes, Denise Wagner, Bob Wiese, Ph.D., Diane Wilson, Barbara Wolfe, Ph.D., Andrzej Zielinski; extra special thanks to Deb Forthman, Ph.D., for extensive editing help; please forgive any omissions.

**Author's Addendum:** Since the original publication of this article in the 2002 Bongo International Studbook, additional bongo calf splaying cases have frequently occurred. Lydia Bosley hopes to update the article in the near future for publication in the Bongo Studbook. Please feel free to contact the author at [LFBosley@Q.com](mailto:LFBosley@Q.com) with any questions or comments.

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# Benefits of Goal-Based Behavioral Husbandry For Captive Bovid and Cervid Species

By Angela Cecil Binney, Disney's Animal Kingdom®  
Julie Hartell-Denardo, St. Louis, MO  
AAZK Behavioral Husbandry Committee

## Introduction

Integrating training and enrichment into the daily management of animals can enhance their welfare ([www.animaltraining.org](http://www.animaltraining.org)). Goal-based programs are designed to encourage specific desirable behaviors and/or decrease undesirable behaviors (AAZK Behavioral Husbandry Committee, 2009). The first step to developing a program for a particular animal or group of animals is to study natural and individual history of the subjects (Mellen and McPhee, 2001). Making a list of desirable and undesirable behaviors is also helpful in planning. These might be lists of management goals or behaviors you would like to encourage or discourage for the overall benefit of the animal, exhibit, or guest experience.



Reeve's muntjac (*Munticus reevesi*) foraging for treats buried under grasses in a bucket.

(Photo: Cathy Keys/Oakland Zoo)

## The Importance of History

An ungulate is defined as, "a mammal with hooves," (Huffman, 1999). Within this definition are many families of varying natural histories. The taxonomic families, Bovidae and Cervidae, include a wide variety of morphology, physiology, and behavior. Bovids include 153 species of cattle, antelope and goats that are divided into eight subfamilies (Vaughan, 2000). With sizes ranging from the 3kg royal antelope (*Neotragus pygmaeus*) to the 1000kg gaur (*Bos gaurus*), the Bovid family is very diverse (Huffman, 1999). Cervidae is the deer family, which includes 45 species of deer that range in size from the 12kg Southern pudu (*Pudu pudu*) to the 700kg moose (*Alces alces*) (Huffman, 1999). Habitats range from mountains to tundra, grasslands, and tropical forests.



Burmese brow-antlered deer (*Rucervus eldi thamin*) and blackbuck (*Antelope cervicapra*) trained to approach a keeper for treats.

(Photo: Courtesy of Disney's Animal Kingdom®)

Some commonalities of the bovid and cervid ungulates are that they are all ruminating, primarily herbaceous, prey animals. They possess degrees of an instinctual behavioral repertoire conducive to seeking food, water, self-maintenance, finding mates and avoiding predation. Some are quite gregarious and live in large herds; while others live a more introverted existence in bonded pairs with offspring. All of these parameters contribute greatly to the style of training and enrichment used with these taxa.

Behavioral disposition of individuals varies greatly with the type of rearing and style of management previously experienced. For example, hand-rearing alters response



to stimuli from that of a parent-reared animal. To help customize a behavioral husbandry program studying the individual history is just as important as the natural history for the species.

## Benefits

There are many proven benefits to using behavioral husbandry techniques with captive bovid and cervid species. The goals and methods may differ from other taxa but the benefits are the same. Training and enrichment enhances animal welfare; provides animals with choices and a sense of control of their environment; enhances the educational experience of zoo guests; and provides a safer environment for animals and keepers, allowing easier and more expansive management options.



Enrichment that requires animals to work for food spreads out foraging time. (Photo: Amy Phelps/Oakland Zoo)

Encouraging natural behavior can provide opportunities for physical exercise, self-maintenance, natural foraging strategies and foster courtship rituals. Animals will express some behaviors innately, often without the aid of a naturalistic environment; however, if necessary elements are absent, all behaviors may not surface. For instance, males of several species of old world deer wallow in urine soaked muddy areas before marking trees during rut (Geist, 1998); however, if they are exhibited in a dry terrain with no access to water or mud, the animal is not likely to exhibit this behavior. In this case, designing or modifying a habitat to include shallow water or muddy wallow areas allows the opportunity to participate in a territorial ritual associated with breeding season.

Enrichment can increase activity and visibility of animals. This not only serves as potential exercise, but also can increase stay time of guests at an exhibit. Increasing guest interest in an animal can foster appreciation and conservation

action. If limitations are placed on exhibit enrichment due to unnatural appearance, many natural materials and environmental changes can be used. In addition to utilizing construction materials with natural appearance, camouflage colored paints have been used successfully to disguise less naturalistic enrichment ungulate enrichment (Roberts, 2009).

Enrichment that appeals to the various sensory perceptions of an animal can add depth and variety to their environment. Scents, sounds, tastes, textures and visual stimuli are various types of sensory enrichment that can be used with ungulates. Varying the intensity, location and duration of these stimuli provides further complexity to sensory enrichment. Tastes can encourage investigative and foraging behaviors while textures might encourage self-grooming and marking. Olfactory and auditory enrichment can be used to invoke social behaviors as well as investigative or avoidance behaviors. Keeping in mind that the range of sensory capabilities for ungulates is different than that of humans, sensory-based enrichment initiatives should be tailored to the species' ability to perceive them as well as not overwhelm them. For example, research into the natural history information of a species may reveal it has a highly sensitive olfactory system that should be considered when determining type, quantity, frequency and location of any scent-based enrichment initiatives.



Audio enrichment can stimulate territorial investigative and prey avoidance behavior. Elk (*Cervus Canadensis*) calling. (Photo: Erica Calcagno/Oakland Zoo)



Although prey species are typically sensitive to changes of environment, altering enrichment items can help animals to become more adaptable and decrease flight response through slow habituation or desensitization (Phelps, Hartell-Denardo, unpublished draft; Burgess, 2003). After a decrease in avoidance behavior, an increase in investigation or interaction with enrichment is often observed. Naturalistic enrichment may be a good starting point for animals that are sensitive to change, as they may respond more positively to browse, tall grasses, a tree, a scent or new food item than to a large brightly colored artificial object. Animals completely naïve to enrichment (and highly sensitive individuals) may benefit from a period of time when new objects are placed within sight but outside of animal access space. Not all bovid and cervids are flighty, so the slow approximation introduction is likely not necessary for all individuals.

An integrated behavioral husbandry program combines enrichment with training. Some enrichment initiatives require learning on the animals' part that may involve some learning in the way of desensitization or habituation. For example, an apprehensive animal may approach a non-food enrichment item for the first time more quickly if the item is baited with browse or food treats.

Training animals to respond to behavioral stimuli provides a tool for communication between keepers and animals and allows voluntary participation in their management. The most basic training strategies are easy to implement and require minimal time. A goal keepers can incorporate into the daily routine is shift training that allows safer access to the habitat for cleaning and maintenance, and closer monitoring of individual behavior and health. Animals can be secured in a smaller area for routine exams, medical treatments, parturition and neonatal care. This eliminates the need to herd them using a flight response or dart them on exhibit.



Shift training gemsbok (*Oryx gazella*) to shift into a holding area.

(Photo courtesy of Disney's Animal Kingdom Lodge®)

Incorporating a training program often results in keepers spending more time observing behavior patterns, which can help with early detection of abnormalities. Wild animals often mask medical symptoms making it difficult to identify the onset of illness or injury, especially in prey species. Sometimes the warning signs are so slight that an untrained eye could miss them. Training allows keepers to be more in-tune with normal behavioral tendencies. This makes the job of identifying changes that could be indicative of a medical issue that much easier.



Chutes originally designed for involuntary restraint can be repurposed to serve as medical training areas, using successive approximation and desensitization methods. Java banteng (*Bos javanicus javanicus*).

(Photo courtesy of Disney's Animal Kingdom®)

Behavioral goals that require long focus time, separation or desensitization to equipment or negative stimuli may be more difficult with extremely flighty species or individuals. However, there are many bovid and cervid species that have been successfully trained to cooperate in medical procedures similar to the current norm for large mammals. Cattle or deer chutes are useful training areas. Routinely shifting through the training area allows habituation to the surroundings, aiding the process.

Medical training decreases the need for involuntary restraint, which is stressful and has potential for injury to animals and staff



and can lead to medical issues or even fatalities (e.g. capture myopathy). It widens the scope of health management options. Veterinary staff may prescribe more diagnostic testing or treatments if these can be done successfully with less stress or risk of injury. Training for tolerance of procedures such as blood collection, administering an injection, hoof treatments, cleaning or treating wounds, fly spray application and diagnostic imaging can help meet the veterinary needs of an animal without the added risk of involuntary restraint.

## Behavior Goals and Assessments



Observing and recording reaction to enrichment helps determine if goals have been met.

Southern reedbuck (*Litocranius walleri walleri*)

(Photo courtesy of Disney's Animal Kingdom®)

Training and enrichment initiatives should be developed with a specific behavioral goal or set of goals in mind. Without goals, it is difficult to know what to look for to determine the effectiveness of the program. Here are some ideas for bovid and cervid enrichment behavior categories: foraging methods, water seeking, social interactions, environmental exploration and utilization, self-maintenance, reproduction, and prey avoidance. Within each category more specific behavior goals can be defined and one initiative can have many goals. For instance, browse can be suspended to encourage overhead browsing. For species that forage on hind legs, such as gerenuk and some deer, the browse could be positioned higher to encourage this feeding strategy, increasing foraging time and physical exercise. Hanging the browse item in a guest viewing area can increase animal visibility, illustrate natural behavior and possibly increase guest stay time at the exhibit.

Training goal categories may include but are not limited to: routine care, management, and medical goals. It is also useful to train flighty non-aggressive species to decrease flight distance, calm disposition,

and increase adaptability. Routine care or management includes: shifting, brief separation, application of fly spray or hoof care products, and administering medications or oral supplements. Medical goals are those beneficial to preventative medicine, and/or treatment of illness or injuries. Not all species will benefit from all of these goals. The appropriateness of a goal for an individual should be assessed based on disposition and capabilities. It is a good idea to approximate from the simplest goals to the more advanced.

Determining effectiveness of an enrichment item or initiative depends on what questions there are in relation to the enrichment. In the case of the overhead browse, many questions may arise that can be answered by collecting some simple data. Did the animals find it? Did they forage on it? Did they stand on hind legs to get high branches? How long did they interact with it? Did guests notice? Did guest stay time increase? Were there any inappropriate or unsafe responses?

Like enrichment assessments, there are many options for recording methods and effectiveness of training. The most useful method depends on the goal. Rating systems, charts or session documentation should be customized to answer questions that may arise about methods used, the animals' response to stimuli, and progress made. For instance if measuring an animal's response to a conditioned stimulus (a behavior cue), a simple recording system might look like this:

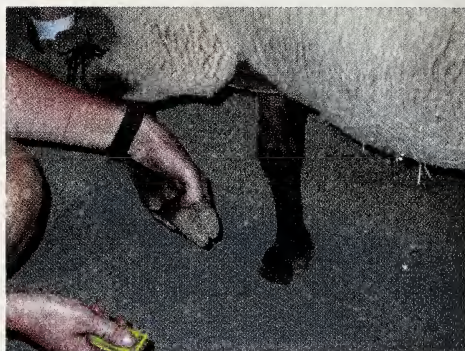
- a) Responded correctly      b) Responded incorrectly      c) Did not respond



If training an individual or small group, the behavior responses can be charted for each animal. However, for behaviors contingent upon a group response (such as shifting into a holding area) it is sometimes easier to chart the group as one response or to record the number with each type of response (e.g. 1.15 shifted in; 2.8 did not). If challenges arise, ad-lib comments are useful in sorting out the details. Although some people like to avoid an overcrowded data sheet, simply stated comments can be very useful in problem solving.

Whatever recording system is designed for training or enrichment, it might be useful to place the charts or logs in a highly visible, easily accessible, weather-resistant location with a pen. If the chart is hidden in a notebook on a shelf or in the manager's office, it is less likely to be recorded daily than if it is on a clipboard or binder hung on a nail in the barn area. This way, information can be quickly jotted down during the keeper's routine.

Because management behaviors happen daily, multiple keepers often train these, increasing the importance of good recording habits. In the initial stages of training, information pertaining to what approximation was worked and a brief description of the session is very useful. This can increase consistency in methods between keepers and help demonstrate when progress is (or is not) made toward the goal behaviors. For instance, if a bolt of lightning sent the animals flying during shift cue association sessions, this is noteworthy. Knowing this, keepers might opt to focus on positive association of the stimulus (i.e. the shift cue) a little longer.



Response to training cues can be recorded to track progress and aid communication.

Training sheep (*Ovis aries*) for voluntary hoof trims. (Photo courtesy of Disney's Animal Kingdom®)



Common eland (*Taurotragus oryx*)  
licking honey off of a Jolly Ball™  
(Photo: Amy Phelps/Oakland Zoo)

## Safety

Safety risks depend on the nature of the animals as well as facility design. Horns and antlers can pose an additional entanglement hazard. Many animals use their horns/antlers to interact with, manipulate and move enrichment objects. Therefore it is important to consider the stability of an object's construction, hole sizes, materials and potential securing techniques to avoid an animal getting an object stuck on or breaking a horn/antler. Rut season is another safety topic to consider when enriching deer and elk species as it can change the way individuals interact with enrichment or the social herd dynamic. The strong flight response of prey species can pose additional safety concerns that should be taken into account. Special consideration should be paid to potential leg, foot and trip hazards when enriching these taxa. When using dietary components with an enrichment initiative it is important to consider both caloric and nutritional specifications and their potential influence in ungulate-related medical concerns including obesity, rumen acidosis, liver abscesses, reproduction, seasonal changes, hoof growth,

etc. With dietary components it is also important to have clearly defined frequencies and measured allotments of approved items. Social risks may include: increased inter or conspecific aggression, increased territorial behaviors, and social displacement or ostracizing.

Some species have the potential to develop dangerous territorial tendencies if trained in close proximity to humans. For example, *Hippotragus sp.* and *Oryx sp.* males and females can be territorial and can inflict appreciable injury to humans. Even smaller antelope males, such as *Gazelle sp.* are more likely





Pre-positioning reinforcement allows scale training without human interaction.

Grant's gazelle (*Nanger granti*).

(Photo courtesy of Disney's Animal Kingdom®)

to be aggressive if flight distance is greatly reduced through imprinting or desensitizing through hand-feeding or hand-rearing. Male deer can be aggressive during rut. These types of animals can be trained more remotely with less human interaction to decrease associated risks.

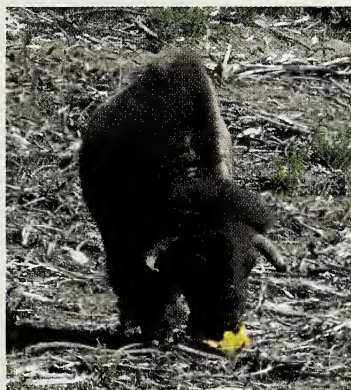
## Conclusion

The benefits of implementing a goal-based behavioral husbandry program for bovid and cervid species are many. Enrichment and training work together to promote animal welfare, encourage natural behaviors, ease of management, and increase guest experience and learning. Use of training and enrichment methods within these taxa has expanded greatly in the past decade and is quickly becoming more common. The more keepers share their experiences through submitting articles and pictures of their programs in the Animal Keepers' Forum

or by presenting their work at conferences, the more these most useful concepts will be implemented in the community of captive hoofed stock keepers.

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Bison (*Bison bison*) enjoying a pumpkin. (Photo: Erica Calcagno/Oakland Zoo)



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Nyala (*Tragelaphus angasii*) calf nursing at Disney's Animal Kingdom Lodge  
(Photo by Courtney Janney, Animal Keeper/Asia Trail, Smithsonian's National Zoological Park)



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